INSIDE A RARE CONSTELLATION • KITT PEAK PHOTO ALBUM

Astronomy®

HDG 08070

October 2000 • $4.50
U.K. £2.70
Can. $6.50

Cosmic Intrigue

Star Clusters Decipher the Galaxy

First Light for Twin Telescopes

When the Stars Burn Out

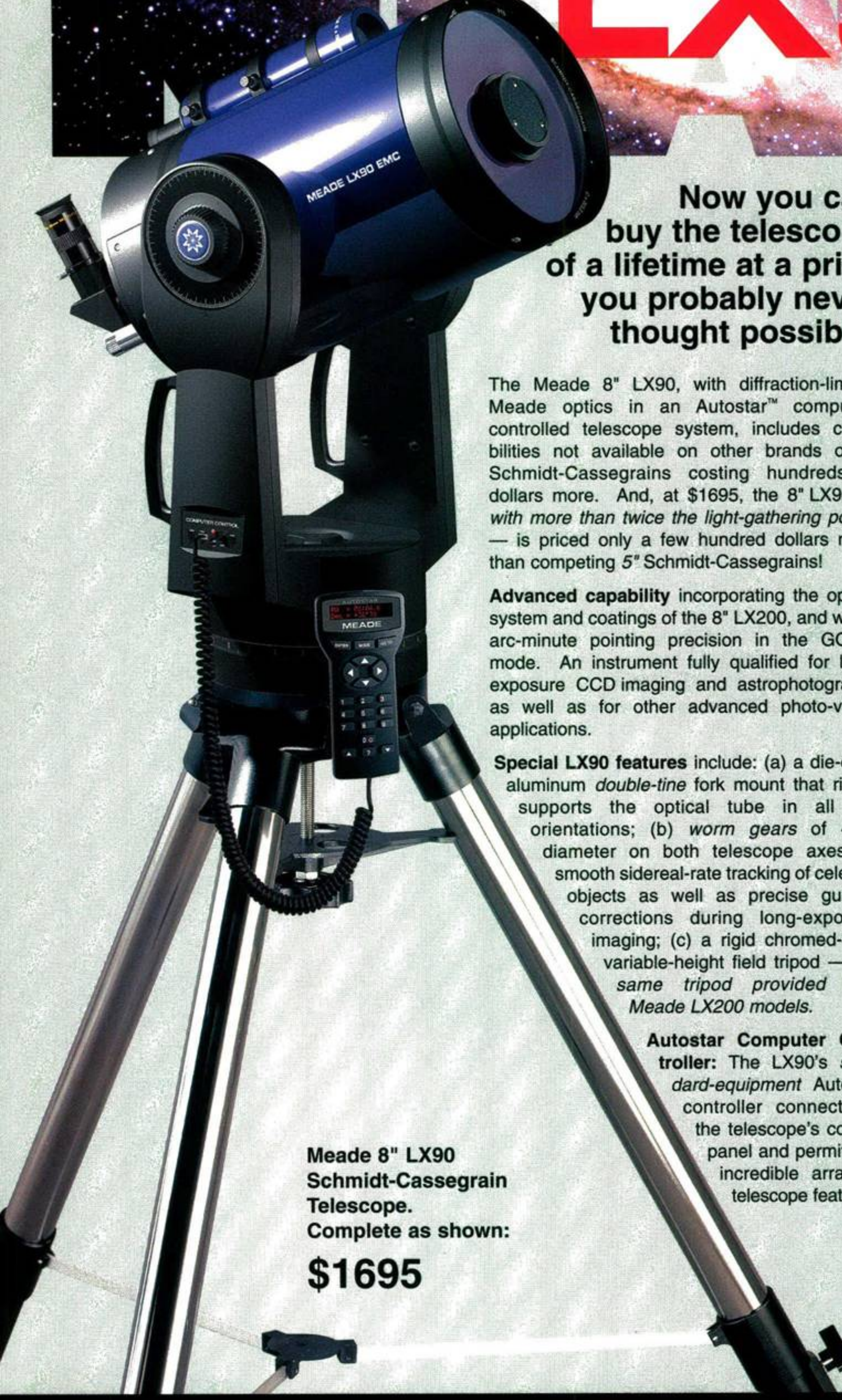
Plus:
Buying a Refractor

www.astronomy.com

10>

0 75470 08070 8

MEADE LX90



Now you can buy the telescope of a lifetime at a price you probably never thought possible.

The Meade 8" LX90, with diffraction-limited Meade optics in an Autostar™ computer-controlled telescope system, includes capabilities not available on other brands of 8" Schmidt-Cassegrains costing hundreds of dollars more. And, at $1695, the 8" LX90 — *with more than twice the light-gathering power* — is priced only a few hundred dollars more than competing *5"* Schmidt-Cassegrains!

Advanced capability incorporating the optical system and coatings of the 8" LX200, and with 5 arc-minute pointing precision in the GO TO mode. An instrument fully qualified for long-exposure CCD imaging and astrophotography as well as for other advanced photo-visual applications.

Special LX90 features include: (a) a die-cast-aluminum *double-tine* fork mount that rigidly supports the optical tube in all sky orientations; (b) *worm gears* of 4.9"-diameter on both telescope axes for smooth sidereal-rate tracking of celestial objects as well as precise guiding corrections during long-exposure imaging; (c) a rigid chromed-steel variable-height field tripod — *the same tripod provided with Meade LX200 models.*

Autostar Computer Controller: The LX90's *standard-equipment* Autostar controller connects to the telescope's control panel and permits an incredible array of telescope features:

- *Automatic GO TO capability* at 6.5°/sec on both axes, simultaneously, to 30,223 database objects, including:

  13,235 deep-sky objects — the complete Messier, Caldwell, IC, and NGC catalogs; 16,888 stars sorted by name and SAO catalog numbers; 8 major planets from Mercury to Pluto; the Moon; 26 asteroids; 15 comets; 50 Earth satellites; plus 200 memory locations for user-defined objects.
- *Automatic GO TO capability* to *any* object of known R.A. and Declination. Plus hundreds of special event menus, guided tours, utility functions, and telescope status options.
- *Nine selectable slew speeds:* 6.5°/sec, 3°/sec, and 1.5°/sec, as well as 128x, 64x, 16x, 8x, 2x, and 1x sidereal.
- *Control of the telescope* through your personal computer. (Requires optional #505 Connector Cable Set.)
- *Fast alignment of the telescope* in either equatorial or altazimuth modes using any of three alignment functions, including the Meade-proprietary Easy Align*.
- *Unlike the hand controllers* included with competing 5" and 8" SCT's, *Autostar is fully upgradeable over the Internet*: the observer can add the positions of new comets, update the positions of Earth satellites, even add new software as it becomes available.

Cordless Operation: The LX 90 is powered at 12 volts DC provided by (user-supplied) C-cell batteries. Alternately, the telescope may be powered from an automobile cigarette lighter plug or from a standard 115vAC home outlet, using optionally available power cords.

* Patent pending.

Meade 8" LX90 Schmidt-Cassegrain Telescope. Complete as shown:

$1695

SPECIFICATIONS: 8" LX90 — Each complete telescope includes 8" f/10 Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings; double-tine fork mount with dual-axis 4.9" worm gears and control panel; electric slow-motion controls on both axes; Autostar hand controller with digital readout display, 9-speed drive controls on both axes, and GO TO controller; 30,223-object onboard celestial software library; internal battery port accepts 8 (user-supplied) C-cells (optional 25 ft. cords permit powering from either 12vDC auto cigarette lighter plug or from 115vAC home outlet); 8 x 50mm viewfinder; 1.25" diagonal prism; Series 4000 Super Plössl 26mm eyepiece; standard field tripod; operating instructions. **$1695.** Packing & shipping in the 48 states: $95.

AUTHORIZED MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 847-367-4600.

EFSTONSCIENCE, Toronto, Ontario, Canada
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario, Canada
Orders & Information: 416-783-4140.

MEADE LX200

The largest-selling serious telescopes in the world are now available at the most affordable prices *ever!*

With their large object databases, fast slewing speeds, and uncanny pointing precision, Meade LX200's are recommended for those amateurs who intend an extensive program of CCD imaging, astrophotography, or deep-space observing. Compare a Meade LX200 feature-for-feature with competing single-tine-fork, spur-gear-driven, GO TO Schmidt-Cassegrains:

Superb Optics: With oversize primary mirrors for greater full-field illumination, LX200 diffraction-limited imaging capabilities are a legend in the industry; we regularly receive reports stating that optical performance approaches that of a fine *ED* apochromatic lens.

Automatic GO TO Capability: Competing 8" Schmidt-Cassegrains claim to place objects "somewhere in the field of view"; Meade LX200's place objects **dead-center** in the field of view, first time, every time, to a pointing precision of **2 arc-minutes or better,** or, with Meade exclusive High Precision Pointing, to a precision of **one arc-minute or better.** *Meade LX200's are the only commercial telescopes ever manufactured that automatically GO TO any input R.A. and Dec., or to any object in the onboard database, to these levels of precision.*

Database of 64,359 Objects, a database *more than three times larger* than competing GO TO telescopes.

Permanently-Programmable Smart Drive™ routinely achieves 5 arc-sec. periodic error, an observatory standard. Other brands of GO TO 8" SCT's decline to state their periodic error and do not offer any programmable error-corrector.

9-Speed Dual-Axis Electronics: Electronics that cover every contingency of telescope positioning — from 2x photo-guide, to 32x image centering, to 8°/sec. slewing across the sky, plus 6 other dual-axis drive speeds in between.

Rigid LX200 Dual-Tine Fork Mountings with Dual 5.75" Worm Gears are the choice of advanced observers, CCD imagers, and astrophotographers for their most sensitive applications. Competing spur-gear-driven single-tine forks can not approach the strength, rigidity, and drive-rate precision built into every Meade LX200 mounting.

Full Long-Exposure Capability: Competing 8" GO TO telescopes describe their capability to take short-exposure "planetary and terrestrial photos," without reference to any long-exposure capabilities. Meade LX200's have been the instruments of choice in **thousands** of the most detailed long-exposure images ever taken by amateur astronomers.

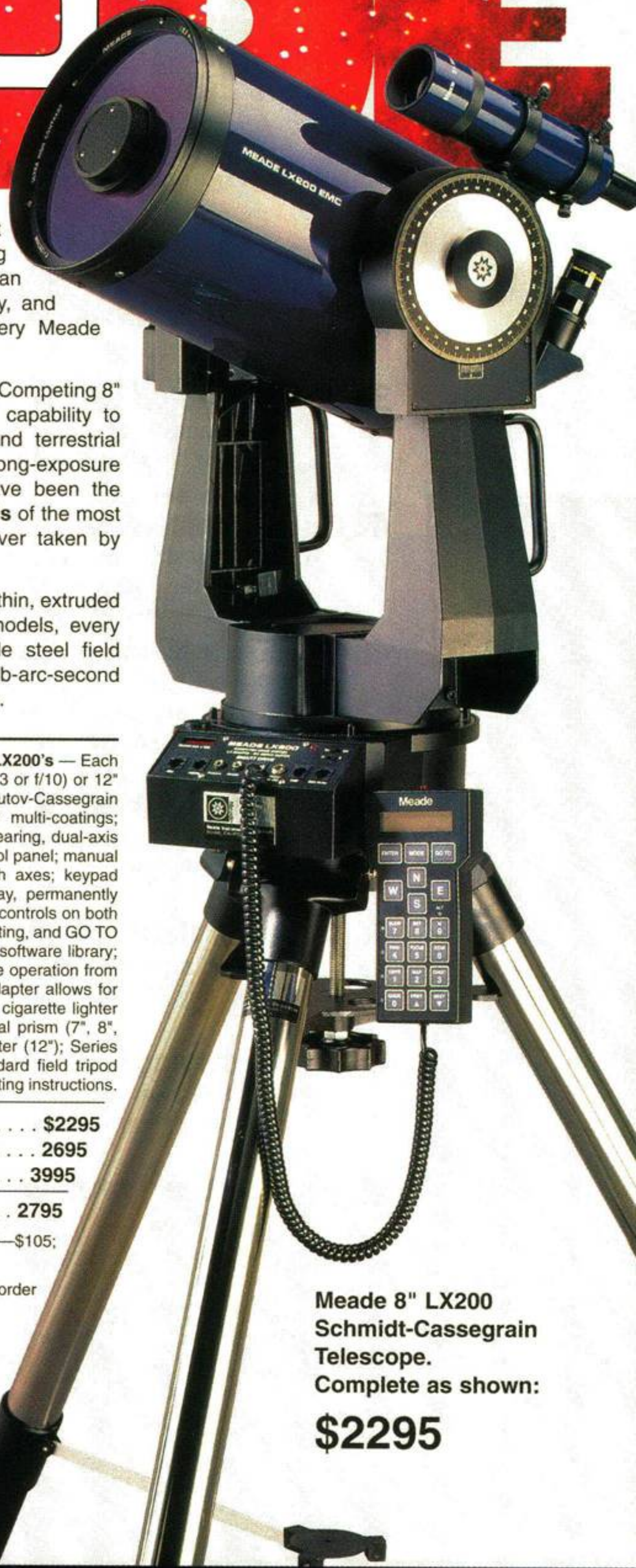
Strong Field Tripods: Unlike the thin, extruded aluminum tripods of competing models, every LX200 includes a fully adjustable steel field tripod perfectly suited to the sub-arc-second resolution of the telescope's optics.

SPECIFICATIONS: 7", 8", 10", and 12" LX200's — Each complete telescope includes 8" or 10" (f/6.3 or f/10) or 12" f/10 Schmidt-Cassegrain or 7" f/15 Maksutov-Cassegrain optical tube assembly with EMC super multi-coatings; heavy-duty fork mount with 4" polar ball bearing, dual-axis 5.75" worm gears, and multi-function control panel; manual and electric slow-motion controls on both axes; keypad hand controller with digital readout display, permanently programmable Smart Drive, 9-speed drive controls on both axes (7-speed on 12"), High-Precision Pointing, and GO TO controller; 64,359-object onboard celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC (optional #1812 Electronic DC Adapter allows for field powering directly from an automobile cigarette lighter plug); 8 x 50mm viewfinder; 1.25" diagonal prism (7", 8", 10") or 2" diagonal mirror with 1.25" adapter (12"); Series 4000 Super Plössl 26mm eyepiece; standard field tripod (7", 8", 10") or giant field tripod (12"); operating instructions.

8" LX200 Schmidt-Cassegrain	**$2295**
10" LX200 Schmidt-Cassegrain	**2695**
12" LX200 Schmidt-Cassegrain	**3995**
7" LX200 Maksutov-Cassegrain	**2795**

Packing and shipping in the 48 states: 8"—$105; 10"—$145; 12"—$215; 7"—$125.

Prices shown are suggested U.S. mail-order retail prices.



Meade 8" LX200 Schmidt-Cassegrain Telescope. Complete as shown:

$2295

New 2000-2001 126-page Meade General Catalog!

Call, write or fax for your free copy.

ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

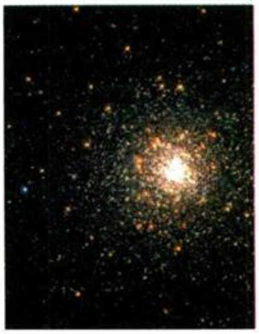
World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur

6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450
FAX: (949) 451-1460 ■ *www.meade.com*

© 2000

October 2000 • Vol. 28, No. 10

Astronomy®



COVER PHOTO: STScI

FEATURES

36 **High-Tech Twin Towers**
The brand-new Gemini observatory telescopes prepare to raise the bar on infrared astronomy. *Rex Graham*

COVER
42 **Cosmic Intrigue**
Globular star clusters hold ancient secrets about the earliest days of the galaxy. *Denise Kaisler*

48 **Embracing the End**
The vast future holds remnants of dead stars in collision, decay of particles, and eternal nothingness.
Fred C. Adams and Greg Laughlin

54 **Catch a Gravity Wave**
The LIGO observatory aims to put Einstein to the test.
Marcia Bartusiak

76 **Kids' Corner: Reflections on Refractors**
A small refractor can be the gateway to a lifetime of observing. *Glenn F. Chaple, Jr.*

80 **Observing Like a Pro**
Kitt Peak's advanced observing program lets you step into the driver's seat with some pretty big scopes. *Adam Block*

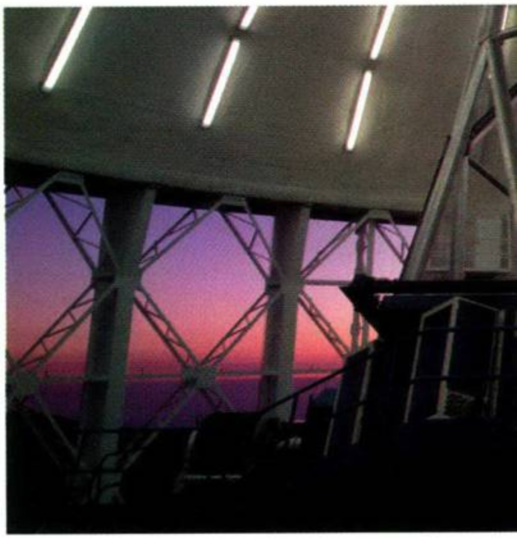
86 **Celestial Portraits: Telescopium, Indus, and Pavo**
Deep southern constellations hide a wealth of galaxies and a few clusters too. *Tom Polakis*

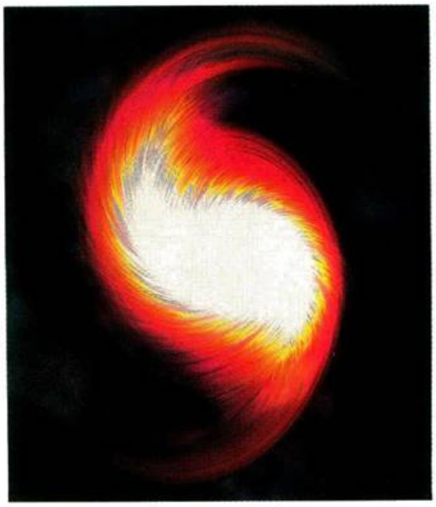
86 A Rare Constellation's Treasures

Luke Dodd

94 Ask Astro

Astronomy: Terri Field





48 When the Stars Burn Out

Astronomy: Elisabeth Rowan

DEPARTMENTS

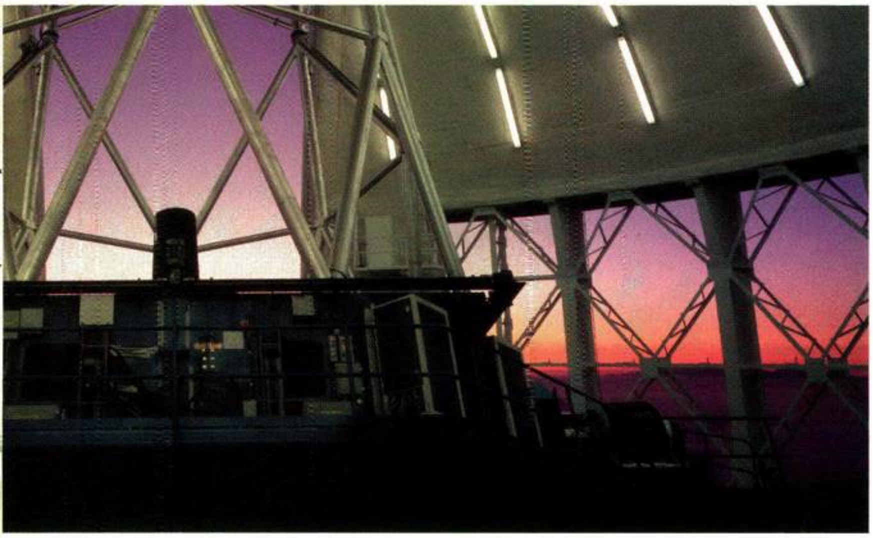
54 Searching for Gravity Waves
LIGO

6 Behind the Scenes
- Launching a Website

14 Talking Back

22 AstroNews
- Water Found Beneath the Martian Surface?
- No Globular Planets?
- It's Raining Deuterium
- New Beast in the Galaxy
- The Mouse That Roared
- Mini-Moon
- The Whole Sky at Your Fingertips

36 Twin Scopes Open Up Nelson Crawford/Polar Fine Arts



42 Intriguing Star Clusters STScI

64 Sky Show
- Aurorae may join Jupiter and Saturn on October evenings. *Martin Ratcliffe and Alister Ling*

94 Ask Astro

98 Strange Universe

102 Star Stuff
Products
- Pocket Planetariums

Books
- *Practical Astrophotography*
- *Wide-Field Astrophotography*
- *Failure is Not an Option*
- *June 8, 2004: Venus in Transit*

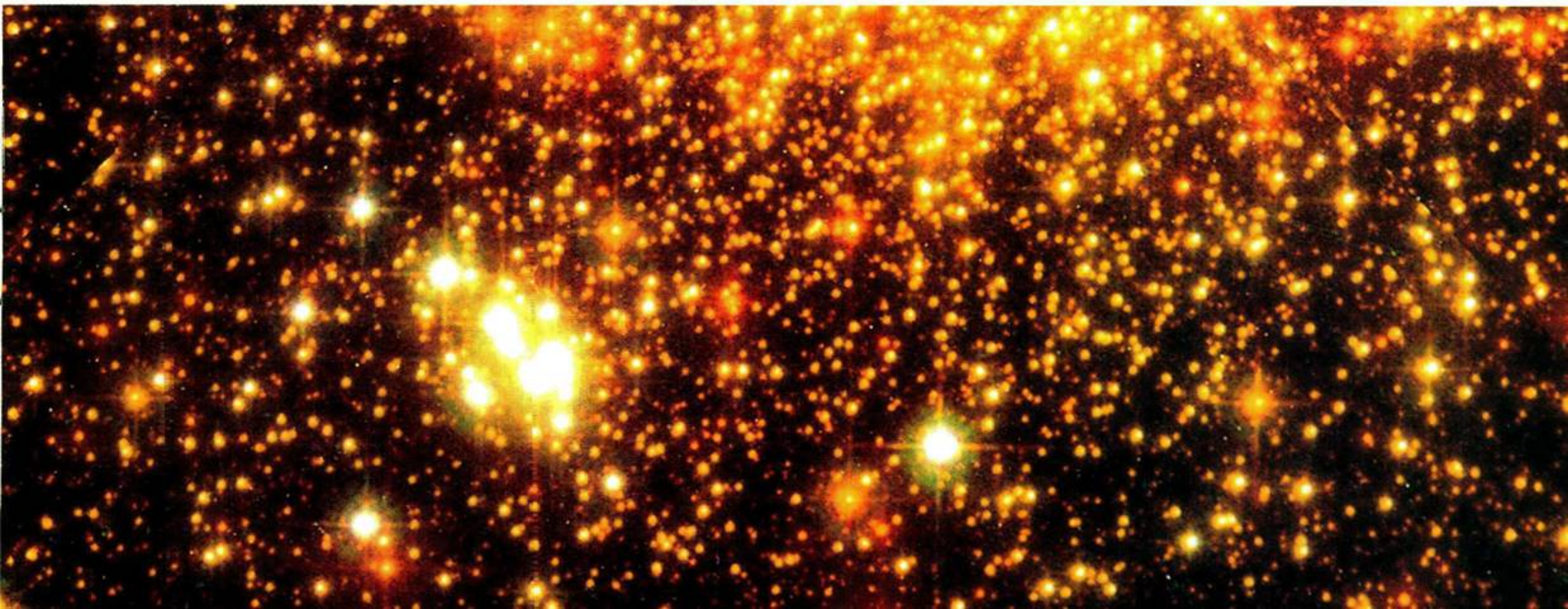
120 Looking Ahead

121 Advertiser Index

123 Hot Shots
- Naked-eye Galaxies

128 Ultimate Exposure

80 Kitt Peak Photo Shoot
Bonnie, Jim, Bryan, and Kelly Mangold



BEHIND THE SCENES

BY BONNIE BILYEU GORDON

Launching a Website

At the beginning of October Astronomy.com launches as a new and separate venture. First begun in 1992 to support *Astronomy* magazine, the website will take on a life of its own this year, with a dedicated staff of six and a much bigger purpose: to bring astronomy to a broader audience.

"Because we have the name 'astronomy,' many casual visitors will find our site easily," says Astronomy.com's editor, Andrea Gianopoulos. "We should be the major portal to everything astronomical, and that's what we intend to become."

Andrea Gianopoulos

James J. Slocum

Dan Koehler

All photos, *Astronomy*: Jim Forbes

The site will include a range of original stories and interactive features including a bulletin service that updates users about events occurring in their region of the sky. The news at Astronomy.com will be updated every day and sometimes on the hour. Astronomy.com will include a mall so that users can purchase telescopes and other astronomy equipment as soon as it's available. This is a particular asset in a hobby whose products are not easily accessible.

The website will also offer educational resources to teachers and parents and provide learning stations for kids of various ages. It will soon offer the opportunity to view online sky events that are visible only in other regions of the world, such as eclipses, meteor showers, and conjunctions.

Let me introduce you to the new staff. You probably know Andrea Gianopoulos because she has been an associate editor with *Astronomy* magazine for three years and writes for us (and for *Scientific American's Explorations* magazine) regularly. She also directed the astronomy education program for the Science Museum of Virginia in Richmond. Andrea has been our webmaster for the past year and understands the importance the website holds for the magazine. The website and the magazine will work together to create projects that will enrich, rather than repeat, one another. She also will introduce new aspects of the magazine to website users, such as our brand-new, searchable index.

Andrea will be supported in her efforts by the publisher of Astronomy.com, who is also the new publisher of *Astronomy* magazine: Jim Slocum. Jim is a thoughtful, hard-working guy who is particularly quick-witted. He thinks up more for us to do than we can ever complete.

Dan Koehler is manager of business development and partnerships for Astronomy.com. Dan is the former advertising manager of *Astronomy* magazine. He'll be overseeing relationships with partners in our website mall, providing another outlet to market and expand the hobby.

Astronomy®

EDITORIAL STAFF

EDITOR
Bonnie Bilyeu Gordon
MANAGING EDITOR
David J. Eicher
SENIOR EDITORS
Rex Graham, Robert Naeye
ASSOCIATE EDITORS
Carol Ryback, Richard Talcott
COPY AND PHOTO EDITOR
Kelly Kizer Whitt
EDITORIAL ASSOCIATE
Terry Williams Conley
EDITORIAL SECRETARY
Julie Sherwin
CONTRIBUTING EDITORS
Robert Irion, Ray Jayawardhana, Patricia Kurtz, Beth Livermore, John Shibley, Tom Yulsman

ART STAFF

ART DIRECTOR
Carole Ross
ASSISTANT ART DIRECTOR
Thomas Ford
GRAPHIC ARTIST
Beth Wesselhoff
ILLUSTRATOR
Elisabeth Rowan
PRODUCTION COORDINATOR
Helene Tsigistras

EDITORIAL ADVISORY BOARD

Buzz Aldrin, Marcia Bartusiak, K.C. Cole, Timothy Ferris, Adam Frank, Paul Hodge, John S. Gallagher III, Anne L. Kinney, Edward Kolb, Alan Lightman, Stephen P. Maran, Boyce Rensberger, James Trefil

Astronomy HOME PAGE The Audit Bureau
http://www.astronomy.com

Astronomy (ISSN 0091-6358, USPS 531-350) is published monthly by Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187. Editorial phone: (262) 796-8776; advertising: (800) 558-1544; customer service & sales: 800-533-6644; outside the U.S. and Canada: 262-796-8776, ext. 421, Monday through Friday, 8:30 A.M. to 5 P.M. CT, Fax: (262) 796-1615; E-mail: customerservice@kalmbach.com. Please include your name, mailing address, and telephone number with any correspondence. Copyright © 2000 Kalmbach Publishing Co., all rights reserved. Material in this publication may not be reproduced in any form without permission. Periodicals postage paid at Waukesha, WI, and additional offices. Printed in the U.S.A. Allow 6 to 8 weeks for new subscriptions and address changes. Subscription rate: single copy: $4.50; 1 year $39.95, 2 years (24 issues) $74.95, 3 years (36 issues) $106.95; Canadian & foreign: 1 year $50, 2 years $95, 3 years $137. Payable in U.S. funds drawn on U.S. Banks. (Canadian price includes GST.) Expedited Delivery Service Surcharges: Domestic 1st Class $30 per year, Canadian air $30 per year, Foreign air, $60 per year. BN 12271 3209 RT. Canada Post Publication Agreement Number 545-775. Not responsible for unsolicited materials. POSTMASTER: Send address changes to *Astronomy*, 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612.

8" LX10

8" LX10 DELUXE

The optical performance of a Meade 8" LX200 Schmidt-Cassegrain...for only $995!

8" LX10: For the serious amateur astronomer on a more limited budget, or for the more casual observer who nonetheless demands the very finest in optical performance, the Meade 8" LX10 satisfies every requirement. *Standard-equipment includes:*

Super-Multi-Coated Optical System: The *exact same* multi-coated 8" Schmidt-Cassegrain optical tube assembly as the more expensive Meade 8" LX200. **Series 4000 SP26mm eyepiece:** Complements the exquisite imaging of Meade 8" SC optics. **Equatorial Fork Mounting:** The relatively light weight, but very stable, LX10 fork mounting provides all of the rigidity required for sensitive high-power applications of the telescope, or for photographic or CCD imaging. **Cordless, DC-Powered Electronic Motor Drive:** With electronically-regulated DC servo motor for automatic *sidereal-rate* tracking; powered by four AA-size batteries that fit conveniently into the telescope's control panel; battery life is in excess of 50 hours. **Worm-Gear System:** The LX10's 5.75"-diameter worm gear produces extremely smooth, regular motion in R.A., with low periodic error — a periodic error that permits such advanced capabilities as long-exposure astrophotography or CCD imaging. **Hand Controller:** Essential for micro-guiding the telescope during long-exposure astrophotography, the LX10's pushbutton hand controller enables precise corrections in R.A. at 2x speed. With the optional electric Declination motor added to the telescope, the hand controller is functional at 2x speeds on both telescope axes.

SPECIFICATIONS: 8" Model LX10 — Includes 8" Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings (D = 203mm; F = 2000mm, f/10); fork mount with setting circles, manual slow-motion controls, and locks on both axes; 5.75" LX worm gear reduction system; sidereal-rate electronically-regulated DC servo motor drive; 4-pushbutton hand controller for 2x speed corrections in R.A.; battery compartment accepting four (user-supplied) AA-size batteries (telescope may also be powered from an auto cigarette lighter plug, using optional 25 ft. cord); 6 x 30mm viewfinder; eyepiece-holder and diagonal prism (1.25"); SP26mm multi-coated eyepiece; standard equatorial wedge with elevation scale, fine elevation control, and 360° azimuth orientation capability; complete operating instructions. **$995.** (+ $65 packing & shipping in the 48 states)

8" LX10 Deluxe: At only $1149 the 8" LX10 Deluxe includes (a) the large-aperture Meade #544 8 x 50mm viewfinder (in place of the standard 6 x 30mm finder); (b) the LX10 Electric Declination Motor System, permitting dual-axis guiding corrections at 2x speed; and (c) Meade Epoch 2000 Jr. Sky Software with 10,000-object database — all at substantially lower cost than if the respective accessories were purchased separately.

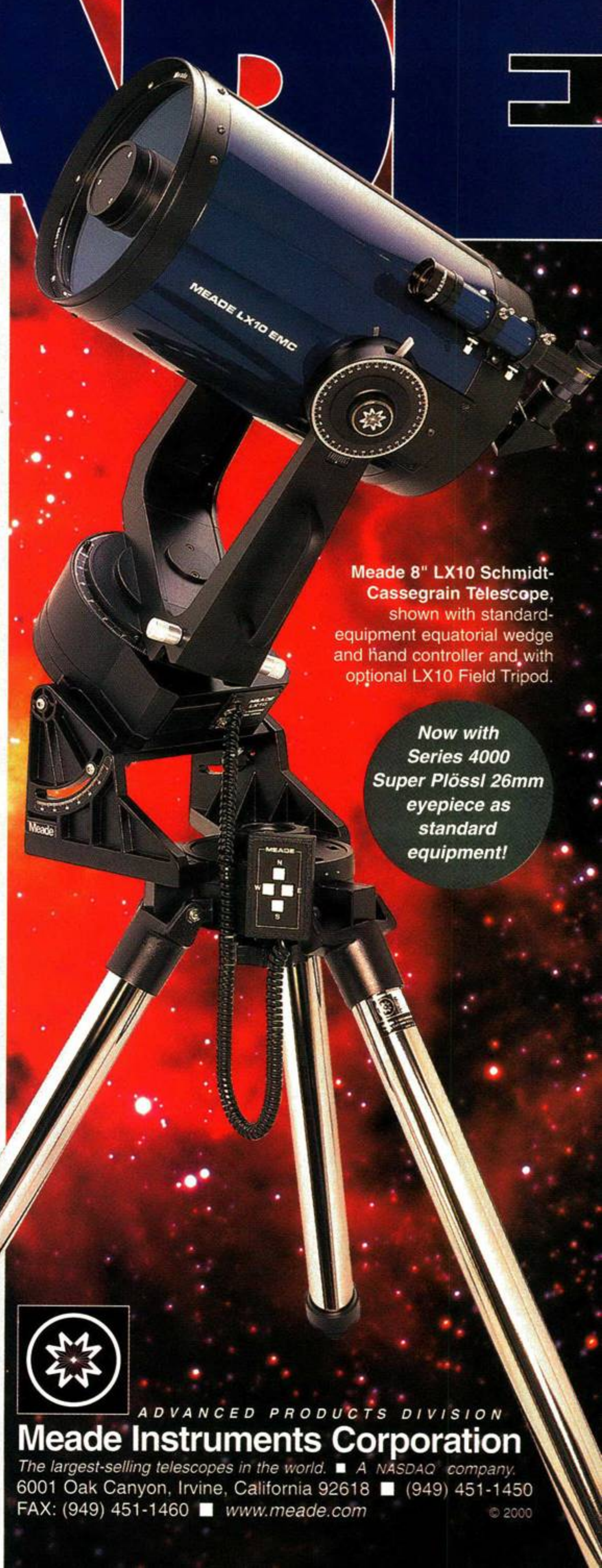
SPECIFICATIONS: 8" Model LX10 Deluxe — Identical in all specifications to 8" Model LX10, above, but with Electric Declination Motor System provided as standard equipment, permitting dual-axis corrections at 2x speed; Meade #544 8 x 50mm achromatic viewfinder in place of 6 x 30mm viewfinder; and Meade Epoch 2000 Jr. Sky Software with 10,000-object database.

$1149. (+ $65 packing & shipping in the 48 states)

Field Tripod for LX10 or LX10 Deluxe	195.
Electric Declination Motor System for LX10	95.
#2014 Magellan I Telescope Computer System for LX10 or LX10 Deluxe, with 12,218-object database	375.

Prices shown are suggested U.S. mail-order prices.

© 2000



Meade 8" LX10 Schmidt-Cassegrain Telescope, shown with standard-equipment equatorial wedge and hand controller and with optional LX10 Field Tripod.

Now with Series 4000 Super Plössl 26mm eyepiece as standard equipment!

ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

The largest-selling telescopes in the world. ■ *A NASDAQ company.*

6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450

FAX: (949) 451-1460 ■ *www.meade.com*

© 2000

MEADE ETX-60AT • ETX-70AT

New!

Now you can join the ETX revolution for as little as $299, complete!

Let Meade high-resolution ETX optics and standard-equipment Autostar controller take you on an automated guided tour of the Solar System, the Galaxy, and beyond. Now even the most novice amateur astronomer can locate and explore the planets, asteroids, and comets, as well as nebulae, star clusters, galaxies, and hundreds of other deep-space objects, at the push of a button.

Fork Mount with Dual-Axis Drive System: In conjunction with the Autostar hand controller, precision worm gear systems on each axis permit smooth pushbutton motions of the telescope, as well as sidereal-rate tracking in the altazimuth mode.

Standard-Equipment #494 Autostar™ Controller: The #494 Autostar includes most of the same features as the more advanced #497 Autostar available for larger Meade ETX models *(facing page)*.

- **Automatic dual-axis GO TO function at 4.5°/sec.** to any of more than 1450 database objects, including the complete Messier and Caldwell deep-space object catalogs, the major planets from Mercury to Neptune, 26 asteroids, 15 periodic comets, and more.
- **Select any of Autostar's** database objects, or any object of known R.A. and Dec, press ***GO TO*** and the telescope automatically slews to the object, placing it in the telescopic field of view.
- **Digital readouts** of telescope position, continuously in R.A. and Dec.
- **9-speed Dual-Axis Operation:** Pushbutton control of the telescope on both axes, simultaneously, at any speed from 2x sidereal to 4.5°/sec., plus sidereal-rate tracking.

High-Resolution Achromatic Objective Lenses: ETX 60mm and 70mm models include multi-coated, air-spaced achromatic lenses of exclusive Meade design; each lens yields razor-sharp images of astronomical and terrestrial subjects.

Flip-Mirror System: Flip the internal optical flat mirror "up" for 90° observing; flip the mirror "down" for terrestrial observing with the optional #933 45° Erecting Prism or for photography with the optional #64ST Photo Adapter.

Cordless Operation: The dual-axis drive of Meade ETX-60AT and ETX-70AT models operates for over 20 hours in the field from six AA-size (user-supplied) batteries which store neatly inside the drive base.

Solar System:
Saturn
ENTER
MODE
GO TO
SPEED
MEADE AUTOSTAR
Guided Tour
Tonight's Best
ENTER
MODE
GO TO
SPEED
MEADE AUTOSTAR
MEADE
COMPUTER CONTROL
ON
OFF
AUX

ETX-70AT: $349,
complete with #494
Autostar Controller

ETX-60AT: $299,
complete with #494
Autostar Controller

SPECIFICATIONS: ETX-60AT and ETX-70AT Astro Telescopes — Each includes achromatic refractor optical tube assembly (D = 60mm, F = 350mm, f/5.8 *or* D = 70mm, F = 350mm, f/5) with multi-layer optical coatings; internal flip-mirror system for either straight-through or 90° observing position; fork mount with electric slow-motion controls, setting circles, and locks on both axes; electronic control panel; 9-speed (2x sidereal through 4.5°/sec.) dual-axis motor drive system with #494 Autostar computer controller; sidereal-rate tracking; internal battery compartment accepting six (user-supplied) AA-size batteries; MA9mm (39X) and MA25mm (14X) multi-coated eyepieces; operating instructions. **ETX-60AT — $299** (+$10 packing & shipping in the 48 states); **ETX-70AT — $349** (+$10 P & S).

OPTIONAL SYSTEMS FOR MEADE ETX TELESCOPES*

#882 Standard Field Tripod (60, 70)	$99.00	#883 Deluxe Field Tripod (90, 125)	199.95
#827 8 x 25mm Right-Angle Viewfinder (60, 70)	49.95	#825 8 x 25mm Right-Angle Viewfinder (90)	49.95
#773 Hard Carry Case (60, 70)	59.95	#774 Hard Carry Case (90)	99.95
#933 45° Erecting Prism (60, 70)	49.95	#775 Hard Carry Case (125)	149.95
#64ST Photo Adapter (60, 70)	19.95	#932 45° Erecting Prism (90, 125)	49.95
#497 Autostar Computer Controller (90, 125)	149.00	#64 Photo Adapter (90, 125)	34.95
#880 Equatorial Table Tripod (90)	29.95	Electric Focuser #1244 (90) *or* #1247 (125)	119.95
#881 Equatorial Table Tripod (125)	59.95		

**see also the Meade accessory ad in this issue.*

MEADE INSTRUMENTS CORPORATION *The largest-selling telescopes in the world.*

MEADE
ETX-90EC • ETX-125EC

COMPUTER CONTROL
MEADE
FOCUS
IN
OUT
SPEED
MODE
MEADE
COMPUTER CONTROL
FOCUS
IN
OUT
SPEED
MODE
MEADE

ETX-90EC: $595, complete with Electronic Controller

ETX-125EC: $895, complete with Electronic Controller

Two advanced apertures:
ETX-90EC — $595
ETX-125EC — $895

Meade® 3.5" and 5" ETX® models include the very latest in microprocessor-controlled capability:

Fork Mount with Dual-Axis Drive System: Each with high-torque DC motors on both telescope axes, permitting electronic operation from the standard-equipment plug-in hand controller.

Pushbutton Electronic Hand Controller: Use at any of four dual-axis speeds: 8x for image centering at high power; 32x for image centering at lower power or for pushbutton object-tracking in the altazimuth mode; 0.75°/sec for image centering in the viewfinder or for terrestrial tracking; 5°/sec for fast slewing across the sky.

Maksutov-Cassegrain Optical Systems: Manufactured at the Meade Irvine, facility, ETX diffraction-limited optics produce images so high in contrast and resolution that ETX telescopes often outperform other telescopes of larger apertures.

Flip-Mirror System: Flip the internal optical flat mirror "up" for 90° observing; flip the mirror "down" for terrestrial observing with the optional #932 45° Erecting Prism or for photography with the optional #64 Photo Adapter.

Cordless Operation: The dual-axis drive system operates for more than 40 hours from eight (user-supplied) AA batteries which store neatly inside the drive base.

Optional #497 Autostar™ Capability: Plug in the optional Meade #497 Autostar computer controller for LX200-type operation, including:

- **Automatic dual-axis GO TO function at 5°/sec** to any of more than 14,000 database objects, including deep-space objects (galaxies, diffuse nebulae, planetary nebulae, star clusters); the 8 major planets from Mercury to Pluto; 26 of the brightest asteroids; 15 periodic comets; and more.
- Select any of Autostar's database objects, or any object of known R.A. and Dec, press ***GO TO*** and the telescope automatically slews to the object, placing it in the telescopic field.
- **Digital readouts** of telescope position, continuously in R.A. and Dec.
- **9-Speed Dual-Axis Operation:** Pushbutton control of the telescope on both axes, simultaneously, at any speed from 2x sidereal to 5°/sec., plus sidereal-rate tracking.

ETX AUTOSTAR
RA = 03:04.6
Dec = +36°38'
MEADE
ENTER
MODE
GO TO
1
2
3
4
5
6
7
8
9
0
?

SPECIFICATIONS: ETX 90EC and ETX-125EC Astro Telescopes — Each includes Maksutov-Cassegrain optical tube assembly (D = 90mm, F = 1250mm, f/13.8 *or* D = 127mm, F = 1900mm, f/15) with EMC super multi-coatings; internal flip-mirror system for either straight-through or 90° observing position; fork mount with electric slow-motion controls, setting circles and locks on both axes; electronic control panel; 4-speed (8x, 32x, 0.75°/sec, 5°/sec) dual-axis motor drive system with hand controller; sidereal-rate tracking in equatorial mode with optional table tripod or deluxe field tripod; internal battery compartment accepting eight (user-supplied) AA-size batteries; 8 x 21mm erect-image (ETX-90EC) *or* 8 x 25mm right-angle (ETX-125EC) viewfinder; Series 4000 Super Plössl 26mm eyepiece (1.25"); instructions. **ETX-90EC — $595** (+ $20 packing & shipping in the 48 states); **ETX-125EC — $895** (+ $30 P & S).

AUTHORIZED U.S. AND CANADA MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 847-367-4600.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

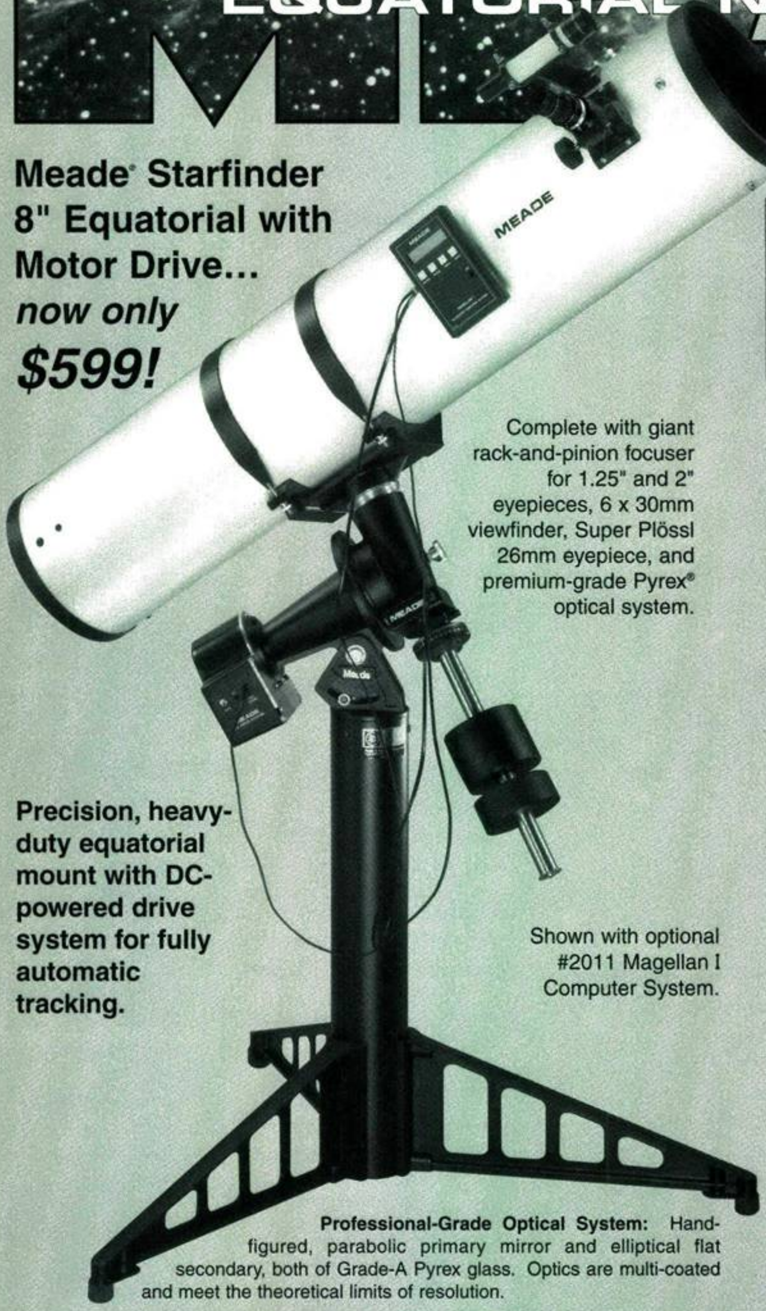
6001 Oak Canyon, Irvine, CA 92618. (949) 451-1450. FAX: (949) 451-1460. www.meade.com

© 2000

MEADE

STARFINDER™ EQUATORIAL NEWTONIANS

Meade® Starfinder 8" Equatorial with Motor Drive... *now only* ***$599!***



Complete with giant rack-and-pinion focuser for 1.25" and 2" eyepieces, 6 x 30mm viewfinder, Super Plössl 26mm eyepiece, and premium-grade Pyrex® optical system.

Precision, heavy-duty equatorial mount with DC-powered drive system for fully automatic tracking.

Shown with optional #2011 Magellan I Computer System.

Professional-Grade Optical System: Hand-figured, parabolic primary mirror and elliptical flat secondary, both of Grade-A Pyrex glass. Optics are multi-coated and meet the theoretical limits of resolution.

Accessories and Components: Premium-grade multi-coated SP26mm eyepiece (1.25"); 6 x 30mm viewfinder with wide 7° field; strong, durable, spiral-wound optical tube with attractive white finish.

Precision Equatorial Mount: Manufactured of machined aluminum to tolerances of .001" or better, with 4"-dia. pier and die-cast tripod legs for rock-solid support of the optical tube. Moves effortlessly from object to object on precision bearing surfaces. Polar and Dec. shafts are 1" solid steel. Setting circles on both axes.

Battery-Powered Cordless Drive System: For fully automatic tracking of celestial objects. Operates over 50 hours from 6 (user-supplied) AA-batteries or from 12v. auto cigarette lighter plug, using optional 25 ft. cord.

2" Giant Focuser: Meade #77 giant rack-and-pinion focuser is included as standard equipment, with eyepiece-holders for both 1.25" and 2" eyepieces.

Starfinder Equatorial 16: Includes equatorial mounting with 1.5" steel shafts, Sealmaster ball bearings, 6" dia. pier, and 6 x AA-size battery-powered worm gear drive; 8 x 50mm viewfinder; #77 giant focuser.

MEADE
MAGELLAN I

Magellan I Telescope Computer System: Use the Magellan I computer to manually slew the telescope quickly to any of 12,218 database objects, or to any object of known R.A. and Dec. Specifications and object database are identical to Magellan I for Starfinder Dobsonians *(see facing page)*.

#2011: for Meade Starfinder Equatorial 6", 8", or 10"	**$295.**
#2012: for Meade Starfinder Equatorial 16"	**295.**

Magellan II Computer-Corrector: Plug the Magellan II into the control panel of your Meade Starfinder Equatorial and you have all the capabilities of the Magellan I, above, including 12,218-object database, *plus* a 4-speed (2x, 8x, 16x, 32x), dual-axis, drive corrector/microslewing system.

#2018: for Starfinder Equatorial 6", 8", 10"	**495.**
#2019: for Starfinder Equatorial 16"	**595.**

Packing & shipping in the 48 states: Magellan I – $15, Magellan II – $20.

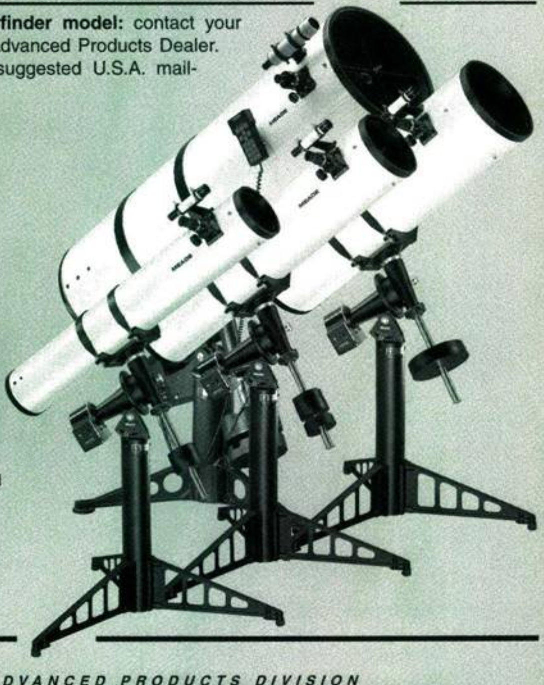
Special Eyepiece Offer! At the time you order any Meade Starfinder Equatorial telescope, you can buy a Meade Series 4000 Super Plössl 9.7mm eyepiece ***for only $29.95!*** *Purchased separately, the SP9.7mm eyepiece sells for $79.95.*

Meade Starfinder Equatorial Telescopes

6" f/8	**$499**	**10" f/4.5**	**699**
8" f/6	**599**	**16" f/4.5**	**2695**

Packing & UPS Shipping Charges to any address in the 48 states: 6"—$65; 8"—$75; 10"—$90; 16"—$55 packing, shipped truck freight collect.

To Order any Starfinder model: contact your authorized Meade Advanced Products Dealer. Prices shown are suggested U.S.A. mail-order retail prices.



New 120-page 2000 Meade General Catalog!

Write, call, or fax Meade Instruments for your free copy.

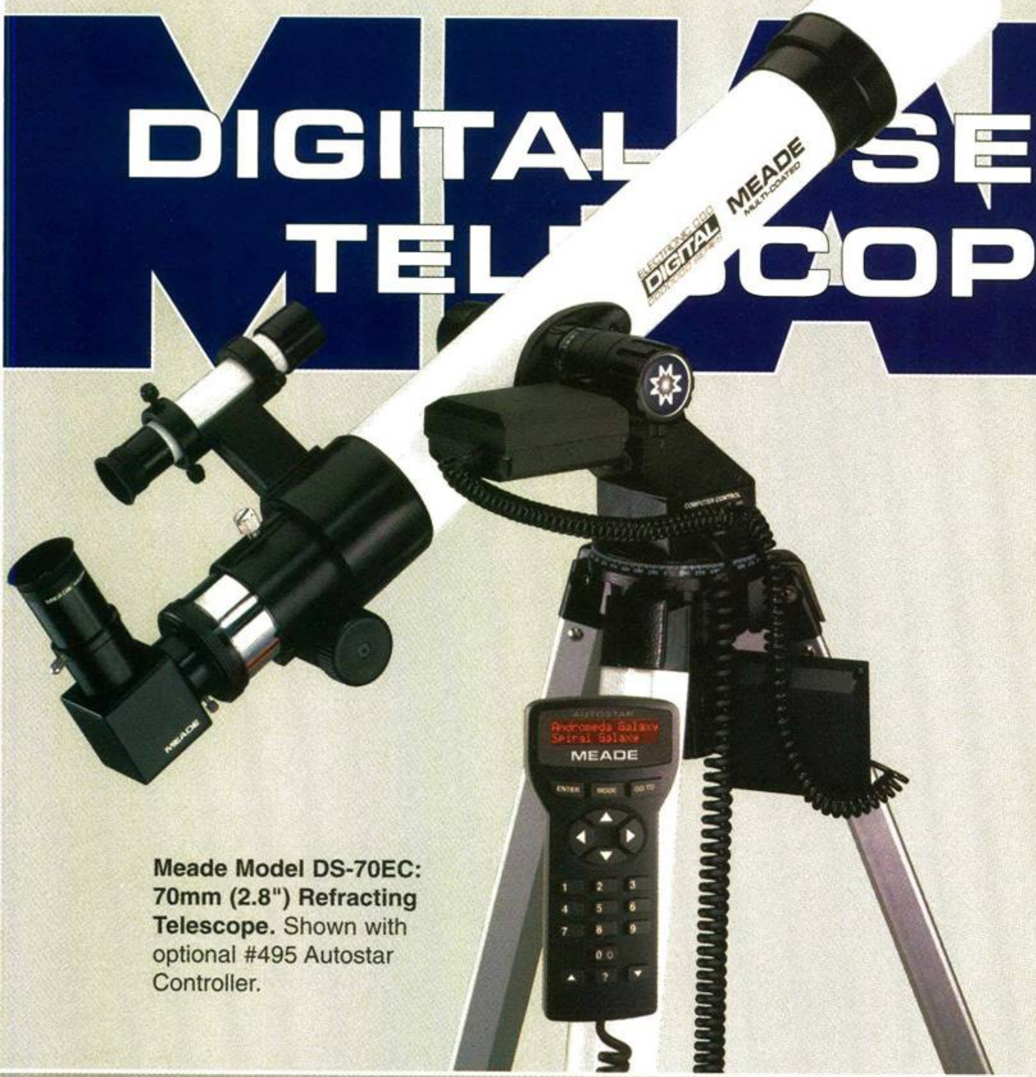
ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

The largest-selling telescopes in the world. ☐ *A NASDAQ company.*
6001 Oak Canyon, Irvine, California 92618 ☐ (949) 451-1450
FAX: (949) 451-1460 ☐ *www.meade.com*

© 2000

MEADE DIGITAL SERIES TELESCOPES



Meade Model DS-70EC: 70mm (2.8") Refracting Telescope. Shown with optional #495 Autostar Controller.

Meade Digital Series (DS) Telescopes offer the widest range of features ever made available in telescopes of their price class. The standard-equipment Electronic Controller (EC) permits precise pushbutton slewing and tracking at any of four speeds. Available optionally, the #495 Autostar Controller allows for automatic GO TO operation.

Digital Electronic Series Telescopes by Meade®: High Technology, Low Prices.

Now even the beginning or casual observer can enjoy the benefits of the very latest in digital microprocessor technology. Meade Digital Series (DS) telescopes are a revelation of electronic capability, premium-grade optics, and mechanical precision.

Electronic Controller: Use the Electronic Controller, provided as standard equipment with all DS-EC models, at any of four dual-axis speeds from 2 arcmins/second to 6°/second, to center and track astronomical objects at any magnifying power.

Altazimuth Mountings: Engineered for smooth dual-axis tracking, Digital Series altazimuth mounts provide a level of mechanical precision previously unavailable on beginning- and intermediate-aperture telescopes.

Optical Systems: Meade DS refracting telescope models include 2-element mulit-coated achromatic objective lenses, precision polished from crown and flint optical glass components. Newtonian reflecting telescopes of the series include primary and secondary mirrors free of the optical zones and irregularities often found on optics of lesser quality.

Optional #495 Autostar Controller: Plug in the Meade #495 Autostar Controller to the control panel of your DS-EC telescope, and you're ready to locate any of over 1500 celestial objects in the Autostar database, including hundreds of galaxies, nebulae, star clusters, the complete Messier and Caldwell deep-space catalogs, and more — all at the push of the GO TO button.

The standard-equipment Electronic Controller of Meade DS-EC models.

Specifications: Each Meade Digital Series telescope described here is *supplied complete* as shown in the photo below, with aluminum field tripod, two eyepieces (1.25"), diagonal mirror, 5 x 24mm or 6 x 30mm finder, Electronic Controller with dual-axis motors, and battery pack (accepts ten AA-size user-supplied batteries.) *See the Meade General Catalog for complete specifications.*

MEADE DIGITAL SERIES TELESCOPES

DS-60EC: 60mm (2.4") Refractor	$299
DS-70EC: 70mm (2.8") Refractor	349
DS-80EC: 80mm (3.1") Refractor	449
DS-90EC: 90mm (3.5") Refractor	499
DS-114EC: 114mm (4.5") Reflector	399
DS-127EC: 127mm (5.0") Reflector	449
#495 Autostar for any above model	99

Prices shown are suggested U.S. mail-order retail prices. Patents pending on DS systems architecture and Autostar.

ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

The largest-selling telescopes in the world. ☐ *A NASDAQ® company.*
6001 Oak Canyon, Irvine, California 92618 ☐ (949) 451-1450
FAX: (949) 451-1460 ☐ *www.meade.com*

© 2000

Left-to-right: Meade DS-60EC, DS-70EC, DS-80EC, DS-90EC, DS-114EC, DS-127EC

RESEARCH-GRADE ACCESSORIES

Series 4000™ Super Plössls
52° field; multi-coated

Meade 4-element Super Plössls, updated and redesigned to utilize the latest in optical glass-types, are the finest general-purpose eyepieces available. For observing hairline lunar and planetary detail, splitting close doubles, or for deep-space; guaranteed to deliver more contrast and image sharpness than any other brand. Rubber eyeguards fold down for eyeglass wearers–a feature not available on competing brands. Multi-coated. All focal lengths through 32mm are parfocal.

Super Plössls (SP; 4-elements; 1.25"; 52°):

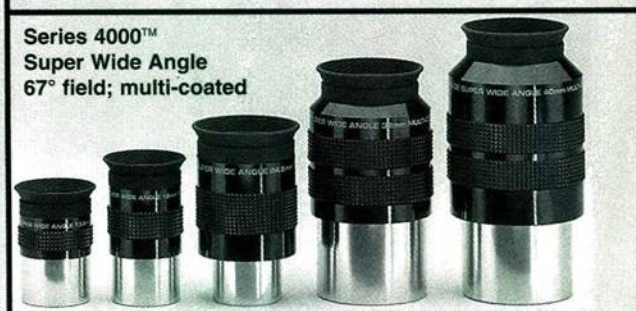
6.4, 9.7, 12.4, 15, 20, 26mm	each:	**$79.95** (4.54)
32mm (52°); **40mm** (44°)	each:	**99.95** (5.26)
56mm (52°; 2")		**199.95** (7.02)

Series 4000™
2x Apochromatic Barlow Lens

#140: The most advanced Barlow lens available for commercial telescopes, the Meade #140 includes 3-element, multi-coated, air-spaced optics. Doubles the power of any eyepiece with which it is used and yields images absolutely unmatched in resolution, contrast and color correction. The #140 optically complements any telescope — refractor, reflector, or Schmidt-Cassegrain. Accepts 1.25" eyepieces. Mechanical components are of machined aluminum and brass. Lens diameter is 28mm; clear aperture 26mm.

$79.95 (5.26)

Series 4000™
Super Wide Angle
67° field; multi-coated



For exquisite wide-angle images at low-to-medium powers, with pinpoint edge-of-field resolution. Ideal for star fields, galaxies, and other deep-space phenomena. SWA 13.8mm, 18mm, and 24.5mm are superb complements to the #140 Barlow, above.

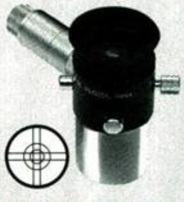
Super Wide Angle (SWA; 6-elements; 1.25"; 67°)–**13.8mm: $139.95** (4.54); **18mm: 149.95** (4.54); **24.5mm: 179.95** (5.26); **32mm** (2"): **239.95** (7.02); **40mm** (2"): **299.95** (7.02)

Series 4000™
Ultra Wide Angle
84° field; multi-coated

The ultimate eyepieces; extreme image sharpness over an amazing 84° field. A perfect optical match with Schmidt-Cassegrains and fast Newtonians.

Ultra Wide Angle (UWA; 8-elements; 1.25"; 84°)– **4.7mm: $169.95** (5.26); **6.7mm: 199.95** (5.26); **8.8mm** (1.25"/2"): **239.95** (7.02); **14mm** (1.25"/2"): **299.95** (7.02)

World's Most Advanced Illuminated Reticle Eyepiece



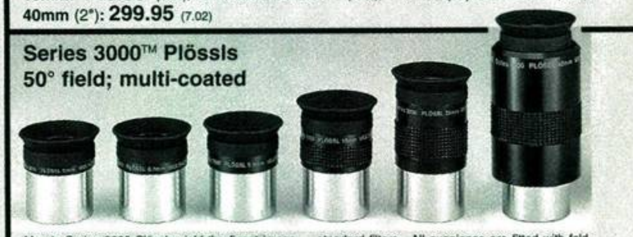
Series 4000 Plössl 9mm, with rubber eyecup and micrometric X-Y positioning of the reticle within the field. Greatly facilitates locking on the guide star. Sharp high-power imaging, excellent eye relief. Wireless red LED illuminator with adjustable brightness control. Multi-coated optics. **Internal batteries included.** Bullseye reticle. 1.25".

$149.95 (6.14)

Series 4000 Plössl 9mm—Same as above but with 6 ft. cord and plug for Meade LX3, LX5, LX6, LX100, LX200, and APO power panels, in place of wireless illuminator.

$129.95 (5.26)

Series 3000™ Plössls
50° field; multi-coated



Meade Series 3000 Plössls yield the finest image corrections obtainable from the classical 4-element Plössl design. Focal lengths from 5mm through 25mm are parfocal, so that, at most, only slight refocusing of the image is necessary from eyepiece to eyepiece. Unlike competing moderately-priced Plössls, Meade Series 3000's are **multi-coated** for maximum light transmission and image contrast. Chrome-plated brass barrels are threaded for standard filters. All eyepieces are fitted with fold-down rubber eyecups for comfortable observing. The PL40mm *(far right in photo)*, an excellent complement to any ocular set, produces spectacular low-power, wide fields, ideal for scanning the Milky Way. Manufactured exclusively to Meade optical designs, Series 3000 Plössls yield fine, high-resolution results on reflectors, refractors, and Schmidt-Cassegrains of any focal ratio.

Series 3000 Plössls (4-elements; 1.25"; 50°)

5, 6.7, 9.5, 16, 25mm each: **$49.95** (3.86); **40mm** (44° field): **$79.95** (3.86)

Series 4000™
f/6.3 Focal Reducer/ Field Flattener

f/6.3 FOCAL REDUCER/FIELD

Manufactured to exclusive Meade optical designs; threads on to any Meade or Celestron Schmidt-Cassegrain rear cell and converts f/10 scopes to f/6.3 (or f/6.3 SCT's to f/4), while significantly flattening the field. Use with SCT visual or photo accessories. Actual visual field is increased by 56%, for fine wide-field views of star fields and nebulae. In astrophotography, reduces exposure times by about 50%, while producing an actual field diameter of 1.5" at the film plane. A tremendous aid with CCD imagers in reducing image size for locating and centering images on CCD chips. 4-element optics; multi-coated; 41mm clear aperture. **$129.95** (5.26)

Series 4000 Photo-Visual Color Filters (1.25")–Premium filters, made of purest crown optical glass, dyed in the mass. For increased contrast and resolution on the Moon and planets. Thread into the barrels of virtually all 1.25" eyepieces sold today. Fully coated.

#8 Lt. Yellow; #11 Yellow Green; #12 Yellow; #21 Orange; #23A Lt. Red; #25A Red; #38A Dark Blue; #47 Violet; #56 Lt. Green; #58 Green; #80A Blue; #82A Lt. Blue each **$14.95** (2.73)

Set #1–4 filters: #12, #23A, #58, #80A	**49.95** (4.54)
Set #2–4 filters: #11, #25A, #47, #82A	**49.95** (4.54)
Set #3–4 filters: #8, #21, #38A, #56	**49.95** (4.54)

Series 4000 Moon Filter (#ND96): Reduces glare and irradiation during lunar observing. 13% uniform light transmission across the visual spectrum. Threads into 1.25" barrels. **$16.95** (2.73)

#911B
#910B
#908B
#911N
#910N
#908N

Series 4000 Nebular Filters—Premium multi-layer interference filters, the finest obtainable. Use broadband ("B") filters to block most forms of light pollution; use narrowband ("N") filters in heavily light-polluted areas or for extremely high-contrast observing of faint nebulae.

#908B–Threads into 1.25" eyepieces, 26mm dia.	**79.95** (4.54)
#910B–Threads into 2" eyepieces, 44mm dia.	**119.95** (5.26)
#911B–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**99.95** (5.26)
#908N–Threads into 1.25" eyepieces, 26mm dia.	**89.95** (4.54)
#910N–Threads into 2" eyepieces, 44mm dia.	**129.95** (5.26)
#911N–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**119.95** (5.26)

#911X
#910X
#908X

Series 4000 Oxygen-III Filters Observe diffuse emission and planetary nebulae as you never thought possible! Exclusive Meade *60-layer* interference coating technology isolates the 496nm and 501nm O-III lines to tremendously enhance observable nebular structural detail in all telescopes.

#908X–Threads into 1.25" eyepieces, 26mm dia.	**99.95** (4.54)
#910X–Threads into 2" eyepieces, 44mm dia.	**159.95** (5.26)
#911X–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**149.95** (5.26)

2x Telenegative Barlow (1.25")

#122: Doubles eyepiece power with sharp, high-resolution, high-contrast imaging on telescopes of all types. 27mm dia. (26mm clear aperture). Excellent corrections for chromatic and spherical aberrations at all photo-visual wavelengths. Multi-coated. 1.25"

$47.95 (4.54)

#905 Variable Polarizer (1.25")

For glare reduction in observing the Moon. Includes two Polarizer filters mounted in a machined cell and permits continuously variable light transmission from 5% to 25%, to compensate for varying lunar surface brightness according to the Moon's phase and the aperture of the telescope. Accepts 1.25" eyepieces. **$49.95** (5.26)

2x Short-Focus Barlow (1.25")

#126: Only 2.5" long, the #126 works well with any telescope accepting 1.25" eyepieces, even those with limited focus range. Maintains the high image quality of the #122, above. Insert the #126 into star diagonal for 2x or insert star diagonal into #126 for 3x. 26mm clear aperture. Multi-coated. **$47.95** (4.54)

Electric Focusers for SCT's

For extremely smooth microfocusing of the image. Does not affect use of the manual coarse-focus knob.

#1206 Electric Focuser: Plugs into control panel of Meade 8", 10", 12" LX200 models and operates from LX200 hand controller. **$149.95** (7.48)

#1205 Electric Focuser: For all other Meade 8", 10", 12" SCT models; includes separate hand controller; accepts one self-contained (user-supplied) 9v. battery.

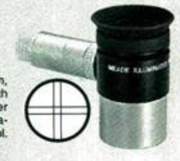
$169.95 (7.88)

Modified Achromatic Eyepieces

Meade 3-element MA eyepieces yield sharp, well-corrected images on the Moon, planets, and deep-space at a reasonable price. Multi-coated; threaded for filters; 1.25" barrel diameter. Apparent field: 40°. **MA 9, 12, 25, 40mm.**

each: **$37.95** (4.54)

MA12mm Illuminated Reticle Eyepiece



Excellent 3-element optical system, long eye relief, fully coated, with double crossline reticle; rubber eyecup. Wireless red LED illuminator and variable brightness control. 1.25". **Batteries included.**

$99.95 (3.45)

As above but with 6 ft. cord and plug for Meade telescopes with power panels, in place of wireless illuminator. **$79.95** (5.26)

2x-3x Variable Barlow (1.25")

#127: Precision internal sliding lens assembly permits continuously variable power settings between 2x and 3x. Engraved scale indicates power in use. Yields bright, sharp, high-contrast images on telescopes of all types. Multi-coated; 1.25".

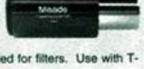
$59.95 (4.54)

2" Diagonal Mirror

#929: Permits use of wide-field 2" oculars. Threads on to rear cell of Meade and Celestron SCT's. Includes multi-coated precision optical flat made at the Meade factory; with 1.25" eyepiece adapter. **#930:** Same as #929 but with 2" barrel to fit into focusers with 2" eyepiece-holders.

#929 or **#930,** each: **$99.95** (6.85)

Camera Adapters



Professional-quality adapters for rigid coupling of telescope-to-camera. Use for either Eyepiece-Projection or Prime Focus. Precision-machined of aluminum and brass, threaded for filters. Use with T-mount, available separately.

.965": **$27.95**; 1.25": **$29.95** (3.86)

Variable-Projection Camera Adapter (1.25")

Machined sliding cell allows variable projection power in eyepiece-projection photography; permits precise selection of correct photo power in lunar and planetary photography; threaded for filters. Use with T-mount for your camera.

$39.95 (3.86)

#777 Off-Axis Guider for SCT's

Internal prism diverts light for monitoring telescopic image during long-exposure astrophotography. Threads to any Meade or Celestron rear cell. Use with illuminated reticle eyepiece and T-Mount for your 35mm camera.

$79.95 (6.85)

45° Erecting Prisms

Fully coated roof prisms to invert the astronomical image in Schmidt-Cassegrains or refractors during terrestrial observations, while presenting a convenient 45° observing angle. Specify **#927** (.965"), **#928** (1.25"), or **#931** (fits .965" focuser, accepts 1.25" eyepieces).

$42.95 (3.86)

Variable Tele-Extender

For eyepiece-projection photography with any Meade or Celestron SCT. Threads on to eyepiece-holder. Sliding cell with lock permits wide range of projection magnifications with the same eyepiece. Use with T-mount for your camera.

$39.95 (3.86)

T-Adapters for SCT's

Rigidly couples camera to telescope for prime focus photography with any Meade or Celestron Schmidt-Cassegrain. Use with T-Mount for your 35mm camera.

$26.95 (3.86)

CCD-Photo-Visual Flip-Mirror Systems

An essential accessory for imaging with ***any*** brand of CCD imager or for astrophotography with a 35mm camera. Flip mirror "down" to center the image while viewing with an eyepiece at 90°; flip mirror "up" to pass light on to CCD chip or 35mm camera film plane. Each unit includes: precision optical-flat Pyrex® mirror; 2-axis mirror-adjustment screws and locks for precise image centering; extra-fine helicoid focusing of the eyepiece; extension tubes for attaching either 35mm camera (using T-Mount) or CCD imager (using either T-threads or 1.25" barrel). Threads to rear cells of all Schmidt-Cassegrain telescopes; may remain on telescope and used in place of diagonal prism for visual observing as well.

"Over the past 10 years I have used all manner of flip-mirrors. The Meade Flip-Mirror Systems are absolutely the best—rock solid, high-precision, beautifully manufactured; they virtually eliminate all flexture between the CCD and telescope." — Jack Newton

#644 Flip-Mirror System: Accepts any 1.25" eyepiece. Mirror clear aperture: 22mm. Use with CCD's up to Pictor 416XT or ST-7, or smaller; or visual observing with 1.25" eyepieces. **$149.95** (7.02)

#647 Flip-Mirror System: Accepts either 1.25" or 2" eyepieces. Mirror clear aperture: 40mm. Recommended for full-field 35mm astrophotography or with CCD's of any size, including all Meade Pictor Series through 1616XT, as well as ST-4 through ST-8; or for visual applications with 1.25" or 2" eyepieces. **249.95** (8.49)

#157 1.25" Adapter: Permits use of either Flip-Mirror on telescopes with 1.25" eyepiece-holders. (Requires approx. 2" additional focus travel with #644, 3" with #647.) **15.00** (3.86)

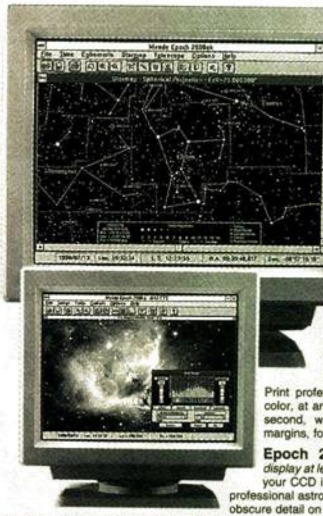
NEW!
MEADE
FLIP-MIRROR SYSTEM

#644

MEADE
FLIP-MIRROR SYSTEM

#647

MEADE
FLIP-MIRROR SYSTEM



Epoch 2000® Sky Software

The most powerful astronomical software ever made available can now be yours for only $149!

Epoch 2000sk *(upper display at left):* Now you can use the most advanced, most precise full-color sky software ever created, to zoom-in on telescopic fields **smaller than one arc second!** With star positions displayed as precisely as **0.01 arc second,** the Trapezium in Orion is no longer shown as a single point, as in other software, **but as four precisely oriented starpoints, just as they appear in the telescope.** No longer do you need to guess the R.A. and Dec. of an object located away from the field center, as in other programs: Epoch 2000sk dynamically reads out the R.A. and Dec. of the cursor position anywhere in the field **and updates R.A. and Dec. instantaneously as the cursor is moved about the field.** Meade LX200 owners can use Epoch 2000sk for remote auto-centering of objects in the telescopic field **to a precision of 30 arc seconds,** routinely!

Print professional-quality star charts in either black-and-white or color, at any zoom setting or sky scale between 180° and one arc second, with your own customized borders, headers, footers, margins, fonts, colors, and grids.

Epoch 2000ip Image Processing Software *(lower display at left)*: Epoch 2000ip makes it easy to enhance and analyze your CCD images with the same sophisticated techniques used by professional astronomers to uncover hidden structure in a spiral galaxy or obscure detail on the surface of a planet. This powerful software includes virtually every technique available for image enhancement. Techniques that bring out detail totally invisible in your original image, transforming it from the ordinary to the spectacular.

EPOCH 2000sk Sky Software: 281,000 objects supplied on 3.5" discs for Windows 3.1 or higher; fully compatible with Windows 95 . . . . **$149**

EPOCH 2000sk-CD Sky Software: 19 million objects, including the complete Hubble Guide Star Catalog; supplied on CD-ROM **179**

LX200 Interface Cable: for Meade LX200 operation by Epoch 2000sk **25**

EPOCH 2000ip Image Processing Software: Supplied on 3.5" discs for Windows 3.1 or higher; fully compatible with Windows 95 . . . . **$199**

4000 f/3.3 CCD FOCAL REDUCER

Series 4000™ f/3.3 CCD Focal Reducer/Field Flattener

NEW!

Revolutionary 3-element Meade design permits ultrafast CCD imaging with **increased** edge-of-field resolution and color correction! Reduces CCD exposure times by up to 80%. Threads on to the rear cell of any Meade or Celestron Schmidt-Cassegrain. Converts f/10 Schmidt-Cassegrain telescopes to **f/3.3** and f/6.3 SCT's to **f/2.** Variable T-Adapter (included) allows range of f/ratios between f/3 and f/5 on f/10 SCT's and between f/1.9 and f/3.2 on f/6.3 SCT's. Use with CCD imagers of any brand and chip dimensions. Not for visual or photographic applications. Multi-coated; 41mm clear aperture. **$149.95** (5.26)

Plössl 25mm Illuminated Reticle CCD Framing Ocular

NEW!
MEADE
PLÖSSL
CCD FRAMING

Displays rectangular frames of all popular CCD chip sizes, including all Meade Pictor models and ST-4 through ST-8. Shows precisely the image size and orientation that appear on CCD chip. Insert directly into telescope eyepiece-holder, or use with Flip-Mirror *(above).* Includes 4-element coated Plössl optics; lockable spacer ring to fix focus position; rubber eyecup; variable LED illumination control; batteries. 1.25".

$129.95 (4.54)

#825 8 x 25mm Right-Angle Viewfinder for ETX-90

Permits comfortable right-angle viewing. Replaces standard-equipment finder on 90mm ETX models, using the same bracket. Wide-angle, achromatic, coated optics; actual field 7.5°. Precise helicoid focusing.

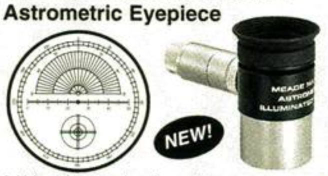
$49.95 (4.26)

#64 T-Adapter for ETX®

Threads to the photo port of all ETX-90 and ETX-125 models. Rigidly couples any 35mm camera with removable lens to the telescope for lunar, planetary, or terrestrial photography. Includes extension tube for longer effective focal length, if desired. Use with T-Mount for your 35mm camera.

$34.95 (3.86)

MA12mm Illuminated Reticle Astrometric Eyepiece



A high-precision eyepiece for a wide range of astronomical measurements. Includes four red-illuminated, laser-etched scales for measuring double star angular separations, position angles, planetary diameters, and lunar crater diameters, and for long-exposure photo-guiding. Modified Achromatic 3-element coated optics; diopter adjustment; rubber eyecup; variable LED illumination control; batteries. 1.25".

$119.95 (4.26)

Series 4000™ 8mm – 24mm Zoom Eyepiece

NEW!

The finest zoom eyepiece available. High-resolution 7-element multi-coated optics, with 55° field at 8mm. Graduated scale in 1mm units indicates exact focal length in use. High-eyepoint yields comfortable observing even with eyeglasses. Internal zoom lenses move on the smoothest, most precisely-machined tracks yet developed for zoom optics. Performance is fully consistent with the finest fixed-focal length eyepieces. Threaded for filters; rubber eyecup; 1.25". **$219.95** (6.38)

MEADE 8mm - 24mm ZOOM

ETX® Hard Carrying Cases

For secure storage or travel with your ETX. Thick-wall construction and die-cut foam lining. Accepts telescope, plus optional eyepieces, erecting prism, table tripod, hand controller, *etc.* Includes two steel latches with key.

#774 Case for ETX-90 models:
99.95 (8.58)

#775 for ETX-125EC:
149.95 (13.38)

#932 45° Erecting Prism for ETX®

For terrestrial observing with any ETX-90 or ETX-125 model. Yields correctly oriented image and convenient 45° observing angle. Threads to ETX rear cell. Accepts any 1.25" eyepieces. Coated roof prism optics.

$49.95 (3.86)

Advanced Field Tripod for ETX-125

#887: Yields *rock-solid* stability for sensitive applications of the ETX-125, even at high magnifications. **Includes fixed-height tripod convenient for standing observations, equatorial wedge with alignment controls in azimuth and latitude angle, and #889 Tripod Adapter for ETX-125.** Permits either altazimuth or equatorial orientation of the telescope for astronomical or terrestrial observing. Tripod legs are 2"-diameter chromed steel. For field use the tripod collapses for easy transport.

$349.95 (14.00)

Tripod Adapter for ETX-125

Included with the #887 Tripod *(above)*, the #889 Adapter is available separately and permits attachment of ETX-125 directly to any Meade LX10, LX50, or LX200 Schmidt-Cassegrain Field Tripod for altazimuth observing or to any Meade Schmidt-Cassegrain Tripod-with-Equatorial Wedge or Superwedge for equatorial applications.

#889 Adapter:
$69.95 (7.70)

ETX® Deluxe Field Tripod

#883: Custom-designed by Meade specifically for ETX-90 and ETX-125 Astro Telescopes. Tripod height adjusts from 34" to 54", for seated or standing observations. Micrometric controls in azimuth and elevation permit precise polar alignment of the ETX fork mount. Tripod head tilts and locks to 90° for terrestrial applications. Telescope attaches to tripod in seconds with 2 thumbscrews. All-aluminum construction.

$199.95 (10.00)

ETX® Carry Bag

Soft-padded Cordura-type carry bag with shoulder strap; permits storage of any 90mm ETX model, plus table tripod legs, eyepieces, other accessories.

$36.95 (5.26)

NEW!

Electric Focusers for ETX®

Meade-engineered for smooth, rapid focusing with any ETX model. Four-speed operation from coarse to microfine. Standard-equipment hand controller accepts one 9v. (user-supplied) battery and focuses all ETX telescopes. Or focus ETX/EC models through the telescope's hand controller.

#1244 Electric Focuser for all ETX-90 models:
$119.95 (6.85)

#1247 Electric Focuser for ETX-125 models:
$119.95 (6.85)

ELECTRONIC CONTROLLER
MEADE

HOW TO ORDER

Prices shown are suggested U.S.A. mail-order retail prices and do not include any applicable sales taxes. Suggested shipping and handling charges to the 48 states by U.P.S. or U.S. Mail shown in ( ) next to each price. **The following national mail-order dealers carry all Meade accessories in-stock for immediate shipment:**

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 312-332-2000.

Canada:

EFSTONSCIENCE, Toronto, Ontario.
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

© 2000

Cosmic Six Pack

Martin Rees's "Just 6 Numbers" in the July 2000 issue is a marvelously brief and lucid summary of current issues in cosmology that inspires further thought.

The fine-tuning puzzle that he ends with is a statement of the age-old wonder that anything at all exists, let alone the intricate universe that we find so beautiful and fascinating. As Rees clearly states, scientific debate on this subject varies with the intellectual fashions and philosophical interpretations of the day.

We are a long way from reaching the point (if indeed it can be attained) at which this choice can be made on objective grounds. In the meantime, if our viewpoints outside science can so profoundly influence how we interpret the unique datum of our existence, to what else might our habits of thought blind us? — *William C. Keel, Tuscaloosa, Alabama*

Rees's article seemed ludicrous to me. It was full of foolish assumptions concerning the tuning of the six dials.

Just because terrestrial life is based on carbon, why can't life in the next universe be based on whatever passes for a periodic table there? These statements added up to: "It's likely ours is the only universe capable of sustaining life." This smacks of arrogance. — *Josh Harmon, Paragould, Arkansas*

NASA/JPL

This Viking Lander 1 photo features a boulder nicknamed "Big Joe" and depicts a martian landscape that dares anyone to conquer and exploit it.

Romancing Mars

I found Joel Achenbach's *Captured by Aliens* (July 2000) fascinating.

However, I believe that the Mars Society and other space colonization societies I find on the Internet share unduly romantic impressions of the colonization of the American West. They choose to ignore the lawlessness, hardships, and genocide that accompanied Western settlement.

Colonization of space will occur, and the process will likely start in the 21st century. The Mars Society and those organizations with similar attitudes should rethink their motives and methods because the routes advocated make it more expensive, more difficult than necessary, and more likely to fail.

Martian settlers will have to cope with being more than 300 million kilometers from Earth. Just a short while ago the U.S. government experienced great difficulty helping a doctor stationed at the South Pole who developed breast cancer during the Antarctic winter. She waited months for rescue until the weather cleared. This, only a few thousand kilometers from home — and on our own planet.

So Mars is not the logical first step. The reason we will eventually colonize the Final Frontier probably has more to do with boldly making profits that no one has made before than for any other reason. — *Mark Bailey, Oxfordshire, United Kingdom*

Achenbach's article intrigued and disturbed me.

I was disturbed and repulsed by the vision of Mars as merely real estate to be exploited. Colonization of Mars to create a redundant terrestrial environment is pointless. The real purpose of space exploration is to learn about the universe and to test our ingenuity, efforts, and courage.

A pivotal step in human development occurred when we took what we knew and put three humans on an untested spaceship propelled by an untested rocket and sent them a quarter of a million miles to visit an alien lunar world.

Seven months afterward, Neil Armstrong remarked that his mission was the first to land in an unknown place without weapons. The exploration of Mars gives us a unique opportunity to continue that vision and create a new tradition — a tradition not of conquest, but of peace and hope. — *Russell A. Hopkins, Cleveland, Ohio*

English Darts

"Missing the Mark" (July 2000) missed the mark by not emphasizing the real cause of NASA's recent failures: the use of "English" units by a scientific organization and its subcontractors. Using feet for distance, as well as using pounds to describe force, is insanely — criminally — wasteful in the 21st century. — *Alex Farkas, Sunnyvale, California*

Astronomy®

KALMBACH PUBLISHING CO.

PRESIDENT
Gerald B. Boettcher

VICE PRESIDENT, EDITORIAL, PUBLISHER
James J. Slocum

VICE PRESIDENT, MARKETING
Michael R. Stephens

VICE PRESIDENT, ADVERTISING
Scott Stollberg

CORPORATE ART DIRECTOR
Maureen M. Schimmel

MANAGING ART DIRECTOR
Lisa A. Zehner

PRODUCTION MANAGER
Annette Wall

CIRCULATION MANAGER
Michelle Spehr

CIRCULATION SPECIALIST
Kirsten King

ADVERTISING DEPARTMENT
(888) 558-1544

ADVERTISING SERVICES MANAGER
Sara Malin Everts

ADVERTISING SALES MANAGER
Howard Hoerl hhoerl@astronomy.com

ADVERTISING SALES REPRESENTATIVE
Michael Ellis mellis@astronomy.com

AD SERVICES REPRESENTATIVE
Tracy Blonien tblonien@kalmbach.com

RETAIL TRADE ORDERS AND INQUIRIES:
(800) 558-1544, ext. 818; outside the U.S. and Canada: (262) 796-8776, ext. 818

SPECIAL E-MAIL ADDRESSES

Ask Astro askastro@astronomy.com

Hot Shots hotshots@astronomy.com

Star Stuff starstuff@astronomy.com

Talking Back talking@astronomy.com

Kids kids@astronomy.com

Customer Service customerservice@kalmbach.com

Ad Sales adsales@astronomy.com

"The Edmund Astroscan... features ...“out-of-the-box” ease of use and transport. ...time-tested design is superior, ...its far better optics give respectable views of highlights like Jupiter's bands and Saturn's rings when mated with an optional 8 to 10mm eyepiece. ...will keep a budding stargazer going for many months without having to purchase other atlases or catalogs."
by Joshua Roth – Sky & Telescope, March 2000

REACH OUT AND EXPLORE THE NIGHT SKY WITH OUR FAMOUS, AWARD WINNING
ASTROSCAN®
WIDE-FIELD TELESCOPE 2001

The ideal first telescope for your entire family!

Unique award-winning compact design allows you to cradle the Astroscan® in your arms or glide it smoothly in its table-top base. Highlights of this scope are its extra wide 3° field and its superb light-gathering ability with a large 4 1/8" clear aperture to resolve panoramic vistas. An optional image erector enables this versatile scope to view land objects.

Telescope Package #AC02-001 for only $299.00 includes:

- Astroscan® 2001 Telescope
- Padded Table-Top Base
- Dust Cap and Carry Strap
- 5 Year ES Limited Warranty
- Instrument-Quality 28mm RKE® Eyepiece
- Open Sight Target Finder
- 36 Page Users Manual
- 40 Page "Sky Guide"

NEW LOWER PRICE! $299.00

New 100 page color catalog has a wide assortment of telescope accessories and scientific products for the entire family.

Order online or call today toll free.

FREE CATALOG
800-728-6999
www.scientificsonline.com

Major credit cards accepted. We back our products with a 30 day unconditional guarantee.

Edmund Scientific Co.
CONSUMER SCIENCE DIVISION
Dept. D00A-C821, 101 East Gloucester Pike, Barrington, NJ 08007-1380
Tel: 856-547-3488 • Fax: 856-547-4826 • E-mail: cons_order@edsci.com
® Scientifics and Astroscan are registered names of the Edmund Scientific Company

THERE IS NO SUBSTITUTE FOR APERTURE

Discovery Truss Designs and Premium DHQ Telescopes Deliver at the eyepiece, where it counts. Expert opticians and master craftsmen combine to produce large aperture telescopes that are unique in today's market. No other telescope combines aperture with the quality and value of Discovery's Truss Designs and Premium DHQ telescopes. All Discovery large aperture telescopes come with a **60 day money back guarantee**. Order yours today.

PREMIUM DHQ

- Baltic Birch base is lightweight and strong
- Your choice of Telrad® or 7x50 finderscope
- Exclusive, huge oversize, adjustable tube bearings
- Unequalled smoothness and stability
- Premium Pyrex® mirror set with enhanced aluminum coatings

12.5" f/5 62.5" (1587mm) $999

14" f/4.5 75" (1905mm) $1299

17.5" f/5 87.5" (2222mm) $1899

TRUSS DESIGNS

- ApplePly construction
- Your choice of Telrad® or 7x50 finderscope
- EbonyStar®/Teflon® bearing surfaces
- 2" Crayford focuser
- Premium Pyrex® mirror set with enhanced aluminum coatings

12.5" f/5 62.5" (1587mm) $1999

15" f/5 75" (1905mm) $2499

17.5" f/5 87.5" (2222mm) $2999

Discovery's complete line of Telescopes, Optics and Accessories

6",8" & 10" Dobsonians

4.5", 6" & 8" Equatorial Reflectors

EQ-RFT Refractors

Custom Optics to 24"

Accessories

Order toll free: (877) 523-4400
www.discovery-telescopes.com

DISCOVERY TELESCOPES

615 South Tremont St.
Oceanside, CA 92054
(760) 967-6598 tel ▪ (760) 967-6798 fax

TALKING BACK

Universal Appeal

The statistics in the editorial response to J. R. McGlown, Jr.'s letter "Good Company" (July 2000) amazed me. *Astronomy* is not just for people with a high income. You don't need a big telescope to enjoy articles like "Just 6 Numbers." I've got a 4.5-inch Newtonian and don't expect to see the same views as the pictures in *Astronomy.*

June's special report on becoming a perfect amateur is a good example of an article for people without a budget of $500 to $1,000. Sky Show lists objects you can see with the naked eye. AstroNews appeals to anyone interested in astronomy. So I think *Astronomy* magazine works for all kinds of people. — *Martijn Weterings, Drunen, The Netherlands*

A Pensive Period

To quote Bob Berman in Strange Universe (July 2000): "If Betelgeuse were represented as a ball with a diameter equal to a 20-story building, a relative Earth would be the period at the end of this sentence."

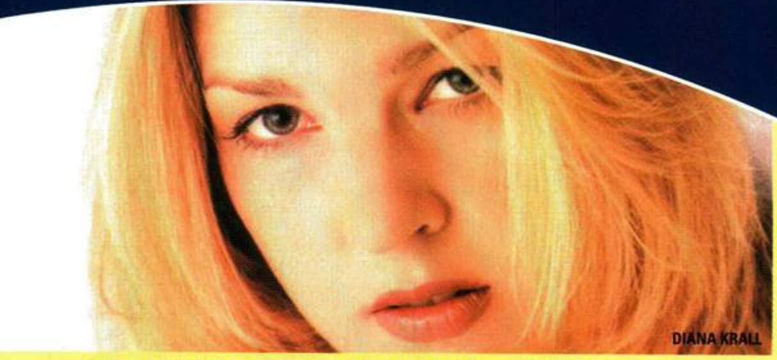
I don't think I've ever stared at a period — or a 20-story building for that matter — for as long as I did after reading his statement. I don't know if I should thank Berman for making me realize how vast the cosmos is, or be mad at him for reminding me how insignificant we Earthlings are. — *Scott Ellison, Montreal, Quebec, Canada*

Strange Error

Bob Berman twice refers to the discovery of Uranus in his July 2000 Strange Universe column. His second reference should instead cite the fact that Galileo unwittingly observed Neptune in 1613 — 233 years before its official discovery. (See *Astronomy*, September 1996, page 48.)

Astronomy *invites you to talk back. Send letters to* Astronomy *Talking Back, P.O. Box 1612, Waukesha, WI 53187; e-mail to talking@astronomy.com. Letters may be edited for space and clarity. Please include your city, state, and country with all correspondence. If you want to talk back to us, please visit our website, http://www.astronomy.com.*

MAKE 2 FREE CUSTOM JAZZ CDs


DIANA KRALL

Start with the music shown here and for thousands more jazz and classical selections visit us at

www.musicmaker.com/freecds

ROMANTIC GUITAR
Earl Klugh
I'll See You Again 1208
John Scofield & Pat Metheny
Quiet Rising 1209
Stanley Jordan
The Lady In My Life 1385
Dwight Sills
Desert Skies 1212
Al Di Meola July 1210
Jim Hall
In A Sentimental Mood 1386
Wes Montgomery
Lois Ann 1382

FREE JAZZ AND THE AVANT-GARDE
Ornette Coleman
The Riddle 1318
Cecil Taylor Steps 1325
Dewey Redman
O'Besso 1326
Eric Dolphy
Out To Lunch 1320
Sun Ra
Stardust For Tomorrow 1321
Archie Shepp
Sonny's Back 1322
Lester Bowie
Rope-A-Dope 1323
Paul Bley Contrary 1324

JAZZ FOR A LAZY AFTERNOON
Dave Grusin Maria 1220
Eliane Elias An Up Dawn 1383
Chick Corea
Samba Yantra 1222
Miles Davis Yesterdays 1223
Herbie Hancock
Watermelon Man 1225
Everette Harp Mercy Mercy Me (The Ecology) 1226
Diana Krall
As Long As I Live 1227
Joe Henderson
Lazy Afternoon 1228

THE JAZZ TITANS
Miles Davis Move 1173
Sonny Rollins Tune Up 1174
Thelonious Monk
Straight No Chaser 1175
John Coltrane Blue Train 1176
Charlie Parker & Dizzy Gillespie
A Night In Tunisia* 1177
Duke Ellington It Don't Mean A Thing (If It Ain't Got That Swing) 1178
Coleman Hawkins Someone To Watch Over Me 1179
Herbie Hancock
Canteloupe Island 1180
Julian 'Cannonball' Adderley
Mercy, Mercy, Mercy 1181

VIVA DIVAS!
Diana Krall Jimmie 1185
Diana Krall
Frim Fram Sauce 1186
Billie Holiday
Them There Eyes 1187
Ella Fitzgerald
Try A Little Tenderness, I Got It Bad...(medley) 1188
Sarah Vaughan
Time After Time 1390
Dinah Washington
Romance In The Dark 1190
Lena Horne Mood Indigo* 1191
Nancy Wilson
On Green Dolphin Street 1192
Betty Carter
My Favorite Things 1193
Cassandra Wilson
Strange Fruit 1376
Carmen McRae Dindi 1391

ON THE COOL SIDE
Miles Davis Jeru 1327
Gerry Mulligan with Chet Baker
My Funny Valentine 1328
Cal Tjader
Mambo Sangria 1329
Lennie Tristano Wow 1330
Lee Konitz/Brad Mehldau/ Charlie Haden
The Song Is You 1331
Jimmy Giuffre Iranic 1332
June Christy
Day-Dream 1333
Stan Getz
Pennies From Heaven* 1387
Jim Hall Chelsea Bridge* 1335

LOUIS ARMSTRONG AT 100!
Basin Street Blues 1245
Mahogany Hall Stomp 1392
Just Squeeze Me (But Please Don't Tease Me) 1393
C'est Si Bon 1394
A Kiss To Build A Dream On* 1395
Honeysuckle Rose 1247
Jeepers Creepers 1250
I'll Be Glad When You're Dead, You Rascal You 1248
I've Got The World On A String 1249
Lazy River 1252

LOUIS ARMSTRONG

THE ART OF THE BALLAD
Billie Holiday
Lover Man 1377
Grant Green
Idle Moments 1257
Lee Morgan Ceora 1259
Benny Green
Summer Nights 1295
Ranee Lee
Summer Knows 1296
Art Farmer
Like Someone in Love 1261
Eric Dolphy Something Sweet Something Tender 1262
Lee Konitz/Charlie Haden/ Brad Mehldau
Body and Soul 1263
Nancy Wilson Lush Life 1294
George Howard
Poet 1284
Ronnie Laws
Solid Ground 1384

TOP BRASS
Lee Morgan
The Rumproller 1267
Donald Byrd Fuego 1268
Kenny Dorham
El Matador 1269
Freddie Hubbard
Hubtones 1270
Miles Davis Woody'n You 1271
Miles Davis Donna 1272
Clifford Brown Cookin' 1273
Horace Silver
Song for My Father 1274
Art Farmer Mox Nix 1275
Chet Baker Imagination 1290
Art Farmer Blue Bossa* 1291
Ornette Coleman
Morning Song* 1292

SMOOTH GROOVES
Pieces of a Dream
Mt. Airy Groove 1276
Dave Grusin Tonight 1277
Najee Sweet Love 1278
Dwight Sills Dreamin' 1279
Medeski, Martin & Wood
Nocturne 1280
John Scofield I'll Take Les 1281
Fattburger Imagine That 1282
Bobbi Humphrey
Harlem River Drive 1283
Brian Hughes Dusk 1289

THE BOP ERA
Fats Navarro
Lady Bird 1303
Dizzy Gillespie & Charlie Parker
Groovin' High 1299
Dexter Gordon
Love For Sale 1300
Thelonious Monk
Round Midnight 1301
Charlie Parker Ornithology 1302
Bud Powell Trio
Bouncing With Bud 1304
Sonny Stitt I Got Rhythm 1306
John Coltrane
Moment's Notice 1298

JOHN COLTRANE

SWINGTIME!
Duke Ellington
Take The 'A' Train 1308
Benny Goodman
Jersey Bounce 1309
Count Basie
One O'Clock Jump 1311
Buddy Rich
I Cover The Waterfront 1312
Harry James I've Heard That Song Before 1313
Stan Kenton
It's Alright With Me 1314
Glenn Miller
In The Mood 1315
Artie Shaw What Is This Thing Called Love 1316

LATE NIGHT SLOW AND EASY
Dexter Gordon
Don't Explain 1198
Chet Baker
Stella By Starlight 1196
Carmen McRae
The Man I Love 1379
Johnny Hartman
Summertime 1378
Milt Jackson
I Should Care 1200
Earl Klugh Catherine 1380
Dave Koz Cara's Theme 1381
Everette Harp
Norwegian Lilies 1203
Janis Siegel (Love Is) The Tender Trap 1204

SUMMER SAXOPHONE
Charlie Parker
Now's The Time* 1232
John Coltrane
Like Someone In Love 1233
George Howard
Family Affair 1234
Sonny Rollins
Sonnymoon For Two* 1235
Najee Najee's Theme 1236
Julian 'Cannonball' Adderley
Country Preacher 1238
Stan Getz
Don't Worry About Me 1239
Joe Lovano I've Got You Under My Skin 1240
David Sanborn & George Duke
Wives And Lovers* 1241
Dave Liebman Group
New Vista 1242

* live recording

musicmaker.com

Order your FREE custom JAZZ CDs today!

1. Choose the songs that you like.
2. Sequence the songs and personalize each disc with a title you create.
3. Return the coupon and receive your first 2 custom CDs FREE (even get a bonus CD at half price: $4.95).

Select from thousands of original recordings on such prestigious labels as Blue Note, 32 Jazz, Pacific Jazz and more. There's no obligation to buy more. Our regular price is $9.95 for the first 5 songs, plus $1.00 for each additional song (there is a charge of 20¢ a minute for any song over 5 minutes).

Visit us online to download FREE songs

www.MUSICMAKER.COM/freecds

© 2000 Musicmaker.com, Inc., 10780 Park Ridge Blvd. Suite 50, Reston, VA 20191

MAIL TO: MUSICMAKER.COM, P.O. BOX 8610, RESTON, VA 20191, OR GO TO WWW.MUSICMAKER.COM/FREECDS

Choose 5 songs per CD, plus add a personalized message/title (UP TO 30 CHARACTERS INCLUDING SPACES):

FREE CD #1 1. 2. 3. 4. 5.
TITLE
FREE CD #2 1. 2. 3. 4. 5.
TITLE

YES! I WANT A BONUS CD AT HALF PRICE ($4.95) WITH THE FOLLOWING SONGS:
1. 2. 3. 4. 5.
TITLE

I LIKE JAZZ, BUT I ALSO LISTEN TO:
☐ CLASSICAL ☐ BROADWAY
☐ NEW AGE ☐ LATIN
☐ POP ☐ NOSTALGIA
☐ WORLD ☐ CLASSIC ROCK

SATISFACTION GUARANTEED: If you are not satisfied for any reason, return CD within 30 days for prompt replacement or refund.

PAYMENT METHOD: ☐ BILL ME CHARGE IT TO MY CREDIT CARD: ☐ VISA ☐ MASTERCARD ☐ DISCOVER ☐ AMEX
ACCOUNT NO. EXP. DATE /
NAME
ADDRESS
CITY STATE ZIP
TELEPHONE ( ) E-MAIL

musicmaker.com

We reserve the right to ask for additional information or to reject any order. Offer limited to new customers only. A shipping and handling fee on each CD and applicable state and local taxes if any will be added.

08-AST

ORION
TELESCOPES & BINOCULARS

Hundreds more products online!
www.telescope.com

Our 25th Year!

TELESCOPES

Orion® SkyQuest™ XT 6" and 8" Dobsonians

STEEL TUBE, NOT CARDBOARD!

Orion SkyQuest XT metal-tube Dobsonian telescopes represent a giant leap ahead in quality and performance over standard Dobs. They boast a durable, enameled-steel optical tube (not cardboard like the competition), which houses expertly crafted parabolic optics guaranteed to be diffraction-limited, for jaw-dropping views of solar system and deep-sky objects. CorrecTension Friction Optimization provides smoother motion and eliminates nagging balance problems. A Teflon-lined aluminum focuser (not plastic), 3-vane secondary mirror holder, improved altitude hub design, and a rock-stable base are just a few of many notable features.

Plus, all these great accessories are INCLUDED: 25mm (48x) and 9mm (133x) Plössl eyepieces (1.25"), 6x30 achromatic finder, eyepiece rack, Moon filter, protective dust cap, and astronomy CD-ROM! Compare to the competition!

Orion SkyQuest Dobsonian telescopes offer absolutely the best value in easy-to-use, mid-aperture telescopes for the serious beginning astronomer.

SkyQuest XT6 (6", f/8)	$369
SkyQuest XT8 (8", f/6)	$499

SkyQuest
SkyQuest
SKY & TELESCOPE HOT PRODUCTS 1999

"The Orion SkyQuest XT8 stands out as the best telescope of the batch..."
— *Sky & Telescope*, from a review of six 8" Dobsonian telescopes (January 2000)

SPECIAL OFFER

Double Power ½ Off!

ORION
Shorty

Shorty™ 2x Barlow

With the purchase of any Orion telescope

Only $22 (Reg. $44.50)

Orion ShortTube 80mm EQ

Our popular ST80 is now available in a portable equatorial package. Super easy to set up, carry, and operate. Its 80mm aperture serves up bright, expansive gulps of sky. The EQ-1 equatorial mount has manual slow-motion controls and accepts an optional EQ-1M electronic drive. Adjustable aluminum tripod with accessory tray. Accessories include a 6x26 correct-image finder scope, correct-image 45° diagonal, and two Explorer II eyepieces (1.25"): 25mm (16x) and 10mm (40x). Comes with 1/4"-20 adapter for coupling tube assembly to mount. Focal length 400mm (f/5).

Only $289

New!

Argonaut™ 150mm EQ Maksutov-Cassegrain

The design heralded for its extraordinary image quality is now very affordable. Comes with precision SkyView Deluxe equatorial mount and gold-anodized aluminum tripod. Effective focal length is 1800mm (f/12), 150mm (nearly 6") aperture. Gearless Crayford 2" focuser, 7x35 achromatic finder, and padded case for OTA.

Just $1099
Tube Assembly only $899

Star diagonal and eyepiece sold separately.

"... visual performance similar to a 4-inch apochromatic refractor costing more than 2-1/2 times as much."
Sky & Telescope (4/99)

SKY & TELESCOPE HOT PRODUCTS 1999

Orion Skywatcher 120mm (4.7") EQ Refractor

Best Buy!

Big-aperture refractor that excels for lunar and planetary viewing, and for deep-space targets too dim for smaller refractors. Multi-coated 120mm achromatic objective lens. The 2"-diameter drawtube accepts 2" or 1.25" accessories. Includes 6x30 finder, 90° mirror diagonal, multi-coated 20mm (50x) and 10mm (100x) Plössls (1.25"). Beefy EQ-3 equatorial mount with aluminum tripod. FREE polar-alignment scope! Dual-axis motor drive optional. Focal length 1000mm (f/8.3).

Low $599

ORION
Where The Stars Are

FREE CD-ROM

with any Orion® astronomical telescope!

An $89 Value

The perfect guide to the sky for new telescope owners!

Requires PC running Windows 98, 95, or 3.1x operating system.

Orion® SkyView™ Deluxe EQ Series

Telescopes for *Today's* Amateur Astronomer

SkyView™ Deluxe 8" EQ Newtonian

A deep-sky lover's delight! Big, diffraction-limited 8" parabolic primary mirror of 800mm focal length (f/4) delivers vivid, wide-field views of nebulas, clusters, and galaxies. Gathers 77% more light than a 6" scope, yet is nicely portable. Enameled steel tube and aluminum R&P focuser (1.25").

$649

SkyView™ Deluxe 6" EQ Newtonian

Outstanding for deep-sky and planetary/lunar study. Features a precision 6"-diameter **parabolic** primary mirror and aluminum R&P focuser. Enameled steel optical tube. Focal length 750mm (f/5).

Was $529 **Now $499**

SkyView™ Deluxe 4.5" EQ Newtonian

An exquisite combination of form, function, and affordability for the serious beginning astronomer. The rolled steel optical tube houses a precision-polished 4.5" primary mirror of 920mm focal length (f/8).

$388

SkyView™ Deluxe 90mm EQ Refractor

Exceptionally crisp views of the Moon, planets, and beyond! Multi-coated 90mm achromatic objective lens of 1000mm focal length (f/11.1). Seamless aluminum optical tube.

Was $488 **Now $449**

NEW 8" EQ!
New Lower Price!
New Lower Price!
Motor Drive Compatible!

ORION

Look What's Included

- *New heavy-duty EQ mount*
- *TWO 1.25" Plössl eyepieces*
- *6x30 achromatic finder scope*
- *Moon filter (1.25")*
- *Gold-anodized aluminum tripod*

FREE!
A $49.95 Value!
Polar-Alignment Scope

Outfit your SkyView Deluxe with an AccuTrack™ Electronic Drive for automatic star tracking.

Now $77

MONEY-BACK GUARANTEE
100% Satisfaction
If you are not completely satisfied with your purchase from Orion Telescopes & Binoculars for any reason, just return it in new condition within 30 days after delivery for a prompt refund.

Visit one of our California Retail Stores!

San Francisco • 3609 Buchanan St., at Bay, 1 block from Marina Safeway • (415) 931-9966

San Jose-Cupertino • 10555 S. De Anza Blvd., at McClellan: from Hwy 280, take De Anza exit; from Hwy 85 take De Anza or Stevens Creek exit • (408) 255-8770

Prices are subject to correction or change without notice.
Promotions are in effect through August 31, 2000

24 Hour Toll-Free Orders: (800) 447-1001
Information/Advice: (800) 676-1343

Information Line Hours: M–F 6am–8pm, Sat. 8am–6pm Pacific Time

www.telescope.com

BINOCULARS

NOW WITH BAK-4 PRISMS!

Scenix™ 50mm

Newly upgraded with BAK-4 prisms for improved images. Multi-coated optics. Metal housing, not plastic. Tripod adaptable. Terrific price! Great gift.

7x50 7.1° field	$79.95
10x50 WA 7.0° field	$79.95

NEW TWIST-LOCK EYECUPS!

UltraView™ 50mm

Extra-long 22mm eye relief makes these superb for eyeglass wearers! Fully multi-coated optics, BAK-4 prisms. New twist-lock eyecups. Tripod adaptable.

7x50 6.5° field	$169
10x50 WA 6.5° field	$169

LONG EYE RELIEF!

Mini Giant™ Binos

Compact astro binocs that show you the light! Fully multi-coated optics, BAK-4 prisms. Long eye relief (8x56: 18mm, 9x63: 26mm). Easily hand-holdable, but also tripod adaptable.

8x56 5.8° field	$149
9x63 5.0° field	$199

TRIPOD L-ADAPTER INCLUDED!

Giant 80mm

Stunning resolution of clusters, nebulas, and lunar surface detail. Fully multi-coated optics with BAK-4 prisms. Objective bridge for added rigidity. Center focus. Tripod L-adapter included. Long 15mm-16mm eye relief.

11x80 4.5° field	$399
16x80 3.5° field	$399
20x80 3.5° field	$399

Free!

LENS TISSUE PAPER

Optics Cleaning Kit

With purchase of any Orion binocular

An $11.95 Value!

TRIPOD L-ADAPTER INCLUDED!

ORION

Little Giant™ II 70mm Binocular

More compact than the original Little Giants. Big 70mm objectives reveal a plethora of nebulous clouds and stellar clusterings. Great for twilight and daytime use too. Sharp, fully multi-coated optics with BAK-4 prisms. Large, knurled center focus wheel. Classic black coarse-grain finish. Tripod L-adapter, case, and deluxe wide neck strap included. Made in Japan.

11x70 4.5° field	$259
15x70 4.0° field	$259
20x70 3.0° field	$259

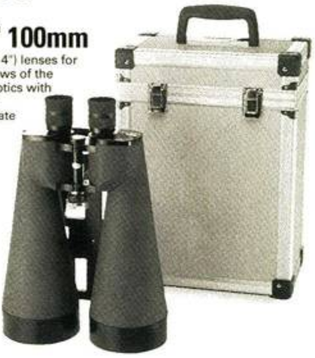
ORION

SuperGiant™ 100mm

Gigantic 100mm (almost 4") lenses for unbelievably detailed views of the heavens! Multi-coated optics with BAK-4 prisms. Platform-type 1/4"-20 mounting plate included. Comes with foam-lined aluminum case.

14x100
Individual focus. 3.3° field.
$999

25x100
Center focus. 2.6° field.
$1149



ORION

80mm Binocular Telescope

INTERCHANGEABLE EYEPIECES!

An unforgettable visual experience! Uses interchangeable 1.25" telescope eyepieces, allowing wide range of powers! Includes two 25mm eyepieces (36x, 1.1° field). Mount/tripod sold separately.
$999

Custom D Altaz Mount/Tripod
Shown here.
$549

Altaz Fork Mount with Cradle
$689

EYEPIECES & ACCESSORIES

Buy 3, Case Free!

FREE Small Aluminum Case!

With purchase of any 3 Sirius Plössl or Explorer II eyepieces
A $24.95 Value!
(Case #5973)

Sirius™ Plössl Eyepieces

You could pay twice the price for other brands of Plössl eyepieces, but why? Sirius Plössls are top-quality, 50° apparent-field (43° 40mm) eyepieces that yield extremely sharp images of impressively high contrast. Ideal for all types of telescopes. Fully-coated optics, rubber eyeguards.

1.25"

6.3mm, 7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm	$49.95 each
32mm, 40mm	$59.95 each

.965"

6.3mm, 7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm	$49.95 each

Explorer II™ Eyepieces

Attractively priced for even limited budgets. Their 3- and 4-element fully coated glass lens configurations provide a 50° apparent field of view. Threaded for filters.

1.25"
6mm, 10mm, 13mm, 17mm, 25mm
$33.50 each

.965"
6mm, 10mm, 13mm, 17mm, 25mm
$27.95 each

Aluminum Accessory Cases

Rugged and classy looking. Pre-cut, cubed foam inside to fit your specific accessories. Ample room for giant eyepieces, camera body, lots of stuff!

Medium Case	$34.95
Large Case	$49.95

Orion Solar Filters

Catch this year's intense sunspot activity with a safe, full-aperture glass solar filter for your telescope. Sizes to fit many telescopes.
From $54.95

ORION EZ Finder

Orion EZ Finder™

Illuminated "red dot" in nonmagnified 9° field of view shows right where telescope is pointed. Adjustable brightness. Attaches to any telescope.
$39.95

Collimating Eyepiece

Combination Cheshire eyepiece and sight tube. Essential for optimizing performance of fast Newtonians. Far less expensive than laser collimators, yet just as effective. Anodized aluminum.
$37.95

Orion Lanthanum Eyepieces

Our rare-earth lanthanum eyepieces have new chrome exteriors but the same superior image correction and generous 20mm eye relief of the previous models. Ideal for eyeglass wearers! Fully multi-coated optics with six to eight lens elements. Apparent field 50° (7.5-25mm), 45° (2.3mm-5.2mm). Pop-down rubber eyecups. Made in Japan. 1.25" barrels.

3.8mm, 5.2mm, 7.5mm, 9.5mm, 10.5mm, 12.5mm, 14mm	$109 each
2.3mm, 18mm, 21mm, 25mm	$119 each

Lanthanum 65° Superwides

Combining long 20mm eye relief, an expansive 65° apparent field, and a rare-earth lanthanum lens element for superior image correction, these oculars are an astronomer's dream come true. Eight lens elements, multi-coated. Fit 1.25" or 2" focusers.

3.5mm, 5mm, 8mm, 13mm	$214 each
17mm, 22mm	$222 each

Buy 3, Case Free!

FREE Medium Aluminum Case!

With purchase of any 3 Orion Lanthanum or Lanthanum Superwide eyepieces
A $34.95 Value!
(Case #5976)

SkyGlow™ Broadband LP Filters

Improves contrast of all objects in moderately light-polluted skies.

.965" $44.95,
1.25" $59.95,
2" $109, SCT Rear Cell $89.95

UltraBlock™ LP Filters

Maximum contrast enhancement for emission nebulas.

.965" $79.95, 1.25" $99.95
2" $139, SCT Rear Cell $129

More than 1000 products in our print and online catalogs!

ORION
www.telescope.com

ORION
TELESCOPES & BINOCULARS
P.O. BOX 1815-A, SANTA CRUZ, CA 95061

Full Online Catalog & More
www.telescope.com

IT'S EASY TO ORDER!

- Call toll-free and charge to your Discover/Novus, MasterCard, or VISA Card, or send your personal check to order by mail. Mail Orders to: P. O. Box 1815-A, Santa Cruz, CA 95061-1815. Fax Orders to: (831) 763-7024.
- California residents add 7.25% sales tax (8.25% in Santa Clara County; 8% in Santa Cruz County; 8.5% in San Francisco).
- Shipping and handling charges additional. Call for rates. Delivery in U.S. and Canada only. Expedited delivery available.
- Prices are subject to correction or change without notice.

FREE 100-PAGE CATALOG
CALL (800) 447-1001

MasterCard DISCOVER NOVUS VISA

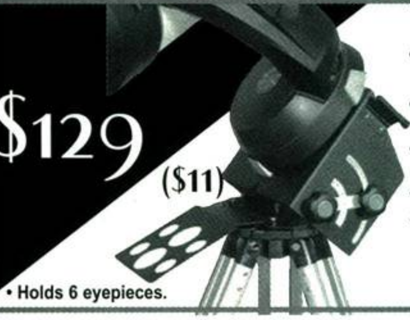
When ordering, mention key code TMA

JMI's (www.jimsmobile.com) ACCESSORIES SHOWCASE

SOLID STEEL
Made in the U.S.A

MEGAWEDGE!

NEW



$129 ($11)

- It holds the ***ETX–90 Astro/90–EC, ETX–125, NexStar 5, NexStar 8.***
- Fits ***NexStar 5/8*** tripod & Meade field tripod.
- ***Now*** – with polar sight tube (folds away when not in use)
- Adjusts from zero to ninety latitude.
- Extremely easy to install with ***JMI's exclusive slide-on mounting.***
- Holds 6 eyepieces.

NEW MEGAPOD

- Convenient storage for your eyepieces
- Convenient holder for your Autostar
- Adjustable legs with bubble level
- ***NO FUMBLING*** to get screws into blind holes – Telescope slides into place

Piggy–Back Camera Mount

For ETX–90, ETX–90EC	$59.95 ($6)
For ETX–125EC	$74.95 ($6)
For NexStar 5	$69.95 ($5)

THAT'S RIGHT!

The ***MEGAPOD*** has blinking red lights at the tips of the feet to prevent accidentally bumping the legs. (The last thing you need is to do a computer star realignment because your telescope accidentally got bumped.) A toggle switch activates the lights.

SOLID AS A ROCK
16 GAGE *Steel Legs*
Thicker than the
Fenders on YOUR CAR!

Folds to 31" – Extends to 50"
Adjustable with latitude scale (0° to 90°).

MEGAPOD for ETX–90, ETX–90EC, ETX–125EC, NexStar 5 $229.00 ($14)

Only tripod available with ***FLASHING LIGHTS***

BEST FOAM IN THE INDUSTRY

Foam Lined Carrying case
for ETX-90 and NexStar 5

- Professional Die-Cut Foam Lining - Top & Bottom (No cubes to fall out).
- Compartment to hold eyepieces, hand controls, etc.

NextStar 5	***$149.95 ($8)***
EXT-90, ETX-90EC	***$109.95 ($7)***

WE DO NOT
Sell ETX or NexStar scopes. EXT and AutoStar are Trademarks of Meade Instruments Corp.

RCF Focuser

Next month–***Winner*** of *"Name the Focuser"* Contest

JMI's *Light–weight* **ANSWER to Plastic Focusers!**
Low–cost
High–quality

PAT PENDING

NEW

1–$1/4$"anodized with stainless steel bearings:	$79 ($7)
2" anodized with stainless steel bearings:	$99 ($7)

CALL NOW TO ORDER!
1-800-247-0304
VISA & MASTERCARD ACCEPTED.

visit our website at www.jimsmobile.com

Schmidt–Cassegrain Focuser

NEW

Manual version of JMI's famous zero–image–shift NGF–S focuser.

Fits Meade and Celestron Schmidt–Cassegrain telescopes (SCT).

Features:
- Extra fine control, one rotation of the knob gives 0.39" travel.
- Low profile adds less than 2–$1/2$".
- Heavy duty, carries 8 lbs.
- Solid anodized aluminum.
- Focus lock.
- 2" output plus threaded output adapter.

All SCT accessories can be used.

NGF–SE Focuser $169 ($7)

INSTAFOCUS-JMI'S NEWEST ETX PRODUCT

NO SURFING FOR FOCUS MODE

The sensible alternative to scrolling through files every time you need to touch up focus or change eyepieces. Saves you lots of time. Does not plug into the Autostar. Motor plugs directly into hand control.
Motor, batteries and cord include.

Insta Focus for the 90EC	$109.95 ($6)
InstaFocus for the 125EC	$109.95 ($6)
MOTOFOCUS for 90 Astro	$99.95 ($6)
MOTODEC for 90 Astro	$99.95 ($6)

InstaFocus hand control snaps onto the Autostar

8:00am to 5:30pm M–TH - 8am to 4pm F (Mountain Time Zone). Prices subject to change without notice.

Jim's Mobile Inc. • 810 Quail St., Unit E • Lakewood, CO 80215 • Orders: 800-247-0304 • Info: 303-233-5353 • Fax: 303-233-5359

The NexStar™ Just Got Brighter!

NexStar™ 8

Introducing the New Celestron NexStar 8.

There is no substitute for size. With Celestron's legendary 8" optics, you can now see deeper into space with the same ease as with the innovative NexStar 5. With the touch of a button, the NexStar 8 will open doors to planets, galaxies and nebulae that you have never experienced in your lifetime. Exquisite design, pinpoint computer control and stability come together in one dynamic package.

Owning a NexStar 8 delivers a host of deluxe features including:

- **8" Schmidt-Cassegrain optics with Starbright coating group** – Large 8" aperture combines with Celestron's proprietary Starbright coatings to ensure maximum visual brightness and detail.
- **Cutting edge NexStar technology**
- **Automated Positioning Telescope** – Telescope easily finds thousands of preprogrammed astronomical objects.
- **Rigid metal fork arm and base construction** – For strength and durability.
- **Adjustable aluminum tripod** – Included standard in this complete system.
- **Photography capable** – Optional accessories allow you to take both planetary and terrestrial photos.

The NexStar 8's advanced computer features include:

- **Auto Align** – Enter your viewing location and time and you're ready to begin observing.
- **Control from your PC** – Communicate with the NexStar 8 via a built-in serial port.
- **Tour Function** – Selects the best and most spectacular objects for you to observe.
- **18,000+ Object Database** – The vast built-in database includes entries from the Messier, NGC and Caldwell catalogs as well as planets, selected SAO objects and 25 user-definable objects.
- **Easy-to-use Hand Control** – Numeric keypad with oversized buttons and red back-lit keypad.

See the NexStar 8 at your Celestron dealer today.

CELESTRON®

Celestron International
2835 Columbia Street • Torrance, CA 90503
TEL: (310) 328-9560 • FAX: (310) 212-5835
www.celestron.com

MARS GLOBAL SURVEYOR

Water Found Beneath

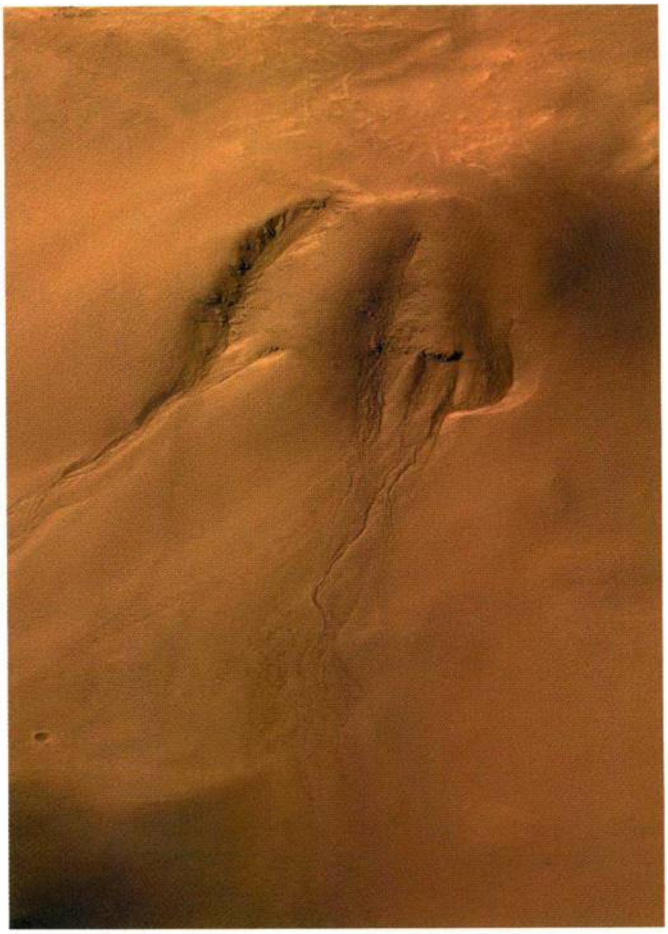
▶ In mid-June, the Internet began to buzz with rumors that the Mars Global Surveyor imaging team was about to announce a major discovery in the professional journal *Science*. The buzz grew so intense that NASA and *Science* took the unusual step of moving a press conference forward in order to announce the discovery a week in advance of its actual publication date.

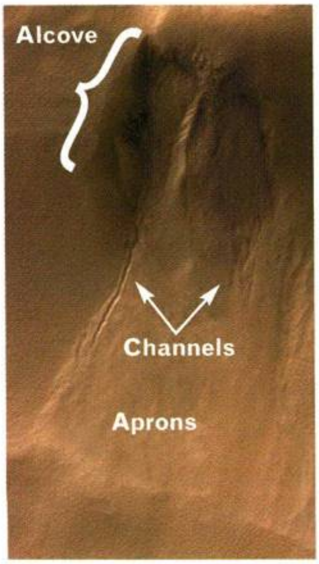
The discovery lived up to expectations. Mars Global Surveyor imaging team leader Michael Malin and his colleague Kenneth Edgett, both of Malin Space Science Systems in San Diego, California, announced that they had discovered as many as 120 locations on Mars where cliffs or crater walls show evidence of seemingly recent water flow. The best examples are truly spectacular. Sharply defined V-shaped gullies originate at small alcoves and run a few hundred yards downhill. Many of the gullies end in aprons of debris.

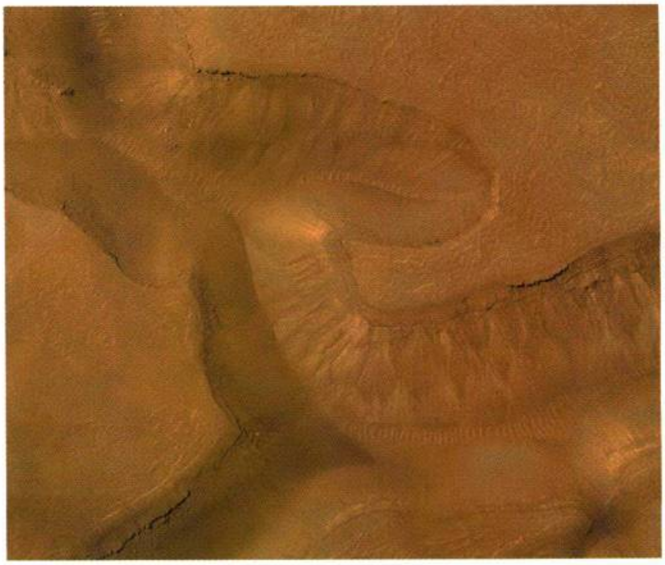
According to Malin and Edgett's interpretation, most of these gullies were formed when a few thousand cubic meters of water (enough to fill seven Olympic swimming pools) gushed out of the hillsides, possibly under high pressure, from underground rivers, or aquifers. Before vaporizing in the thin martian air, the water carried rocks and debris downhill, forming the aprons. The flows may have shut off when the water froze or was sealed by dirt or ice dams after the initial outbursts.

"If these features had been found on Earth," says Malin, "there would be absolutely no question that water was associated with their formation."

But how old is "seemingly recent?" Malin and Edgett note that some of the gullies are sharply defined, free of dust deposits, and unscarred by impact craters. This implies that the features are young. They could have formed within the last few hundred thousand years, but scientists can't rule out the possibility that they continue to form in contemporary time.



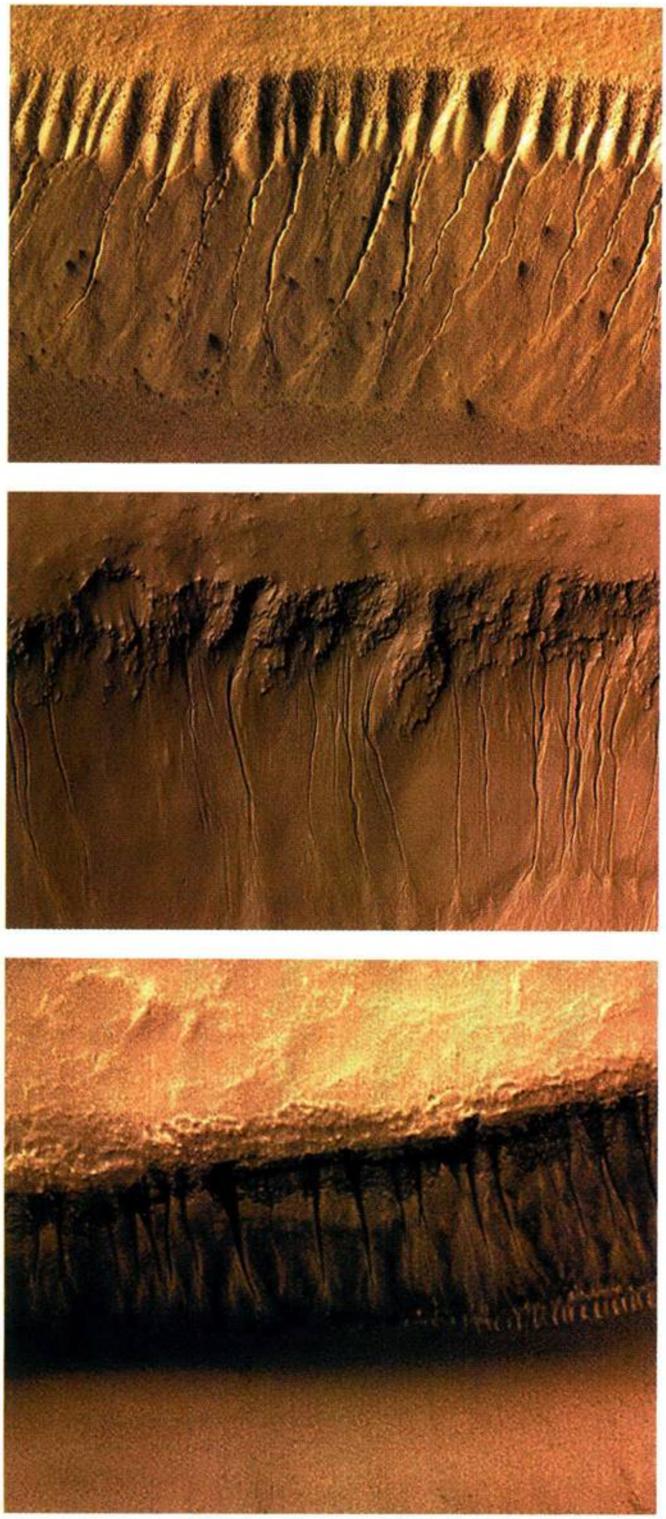




High-resolution images from Mars Global Surveyor show more than 100 locations where liquid water appears to have burst out from cliff sides or crater walls, carrying rocks and dirt downhill to form gullies and aprons. The water may originate from underground rivers, known as aquifers.

All images: Malin Space Science Systems/NASA/JPL

the Martian Surface?



Most of the gullies are located far from the equator, perhaps because the water comes from melted permafrost, and permafrost is more common at higher, colder latitudes. The lack of impact craters in the gully regions supports the idea that these features are young, meaning water may be flowing just a few hundred yards below the surface at the present time.

Malin and Edgett note that most of the gullies are at least 30° poleward of the equator. In addition, the rock faces generally point toward the poles. This is contrary to what some scientists had expected, because warmer temperatures near the equator would help keep subsurface water in a liquid form.

Several scientists have expressed skepticism, noting that water at these high latitudes should remain frozen to depths of 2 to 4 miles. But Malin and Edgett's interpretation is consistent with other recent results. Mars Global Surveyor images had already suggested that Mars's much larger dry river channels were not formed by runoff of surface water or ancient rains, but rather were associated with erosion created when subsurface water gained access to the surface. This action eroded channels and also caused the headward end of channels to cut back into the landscape in a process called sapping. Some of Mars's dry channels show collapse pits where the ground probably collapsed into aquifers.

In addition, University of Arizona researcher Tim Swindle and his colleagues have analyzed a martian meteorite in which minerals were created when the rock was exposed to liquid water. These minerals date to only 670 million years ago. This may sound ancient, but it is young in the sense that it confirms that liquid water existed near the surface within the last 15 percent of martian history.

Research by our own team at the Planetary Science Institute in Tucson, Arizona, may help explain how water could exist in liquid form so close to the surface. We found lava flows that appear to be 10 million to 100 million years old. This shows that geothermal heating has occurred in modern times. The aquifers are probably created when geothermal heating melts the underside of ice or permafrost layers in the martian soil, creating liquid water perhaps a few hundred yards below the surface. The gullies found by Malin and Edgett arise when these aquifers break out of cliff sides.

Existence of underground liquid water on Mars would have profound implication for human exploration. If geothermal areas can be identified, drill holes could produce water as well as geothermal power. Such aquifers would also be natural locales in which to look for martian microbial life. — WILLIAM K. HARTMANN, MARS GLOBAL SURVEYOR IMAGING TEAM

EXTRASOLAR PLANETS

No Globular Planets?

▶ When you look at a globular cluster through a telescope, you might envy the creatures living there. With hundreds of thousands of stars crammed within a sphere 100 to 150 light-years across, globular residents would enjoy a night sky packed with hundreds of stars brighter than the brightest in our night sky.

Unfortunately, there might not be anyone to appreciate the view. Recent Hubble Space Telescope observations suggest that planets are rare or nonexistent in at least one globular, 47 Tucanae (NGC 104), one of the crown jewels of the Southern skies.

In July 1999, a team of 24 astronomers led by Ronald Gilliland of the Space Telescope Science Institute and Tim Brown of the National Center for Atmospheric Research aimed Hubble for 8.3 straight days at 47 Tuc. Gilliland and Brown's team was hoping to catch planets crossing the disks of some of 47 Tuc's stars — events known as transits. Specifically, the team expected to see transits caused by hot Jupiters — giant planets that circle their host stars in extremely tight orbits.

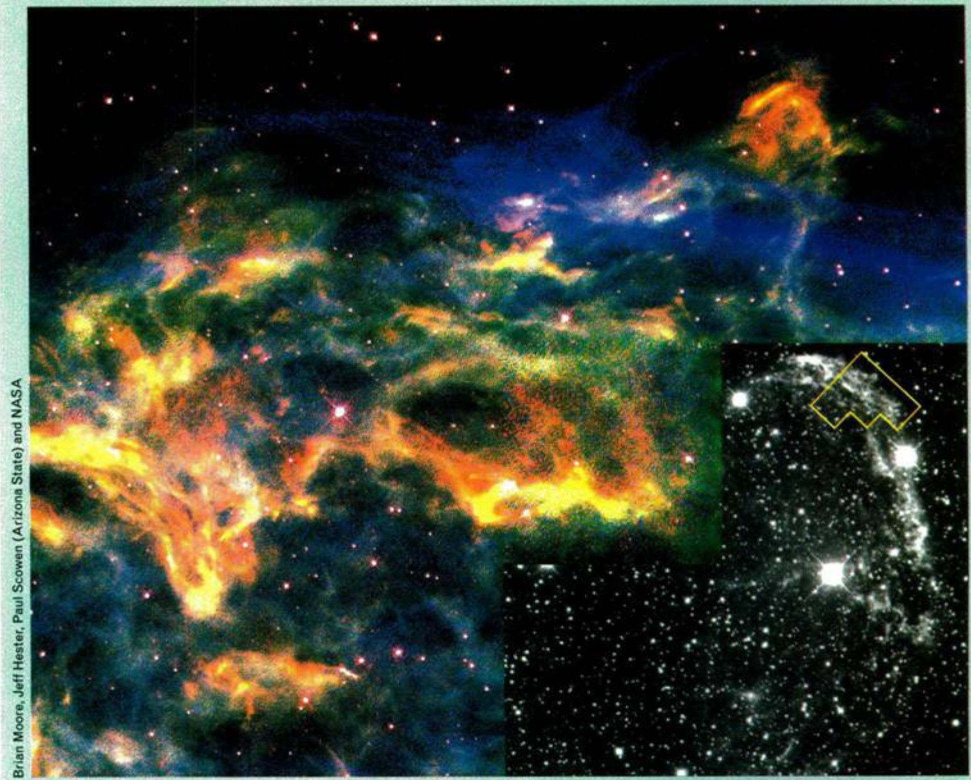
Planet hunters have found that about 1 percent of stars near the sun are orbited by hot Jupiters. If the same ratio held true in 47 Tuc, Gilliland and Brown's team would have seen up to two dozen transits. Instead, they found none in the 34,000 stars they examined. The mighty Hubble struck out.

"There's something about the cluster environment that interferes with the process of making planets, transporting them close to the star, or allowing them to survive," says Brown.

One possible explanation for the paucity of planets is 47 Tuc's dense stellar environment. Passing stars might gravitationally strip planets from stars or disrupt protoplanetary disks before planets have a chance to form. "Planetary orbits might not be stable because of frequent close stellar encounters in globular clusters," says Gilliland.

Chemical composition may also play a role. Like most of the Milky Way's 147 known globulars, 47 Tuc contains very old stars. These stars formed in the early universe, when there was plenty of hydrogen and helium to make stars. But this was before stars had synthesized a large supply of heavy elements such as carbon, oxygen, silicon, and iron — the raw materials from which planets are made. Indeed, almost all the known planet-bearing stars are extremely well endowed with heavy elements.

CRESCENT NEBULA



Brian Moore, Jeff Hester, Paul Scowen (Arizona State) and NASA

Kim Zussman

A RAGING STELLAR WIND sweeps up gas into knots and filaments in this new false-color Hubble Space Telescope image. The Hubble field captures a 3-light-year-wide portion of the Crescent Nebula (NGC 6888), located 4,700 light-years away in Cygnus. The massive star WR 136, located at the right center of the ground-based telescope image at the lower right, is spewing a furious stellar wind as it lives out the final years of its life. The wind rips through space at 3.8 million miles (6.1 million km) per hour. The Hubble image shows what happens as the wind slams into a slowly expanding shell of gas that the star ejected 250,000 years ago when it was a red supergiant. WR 136 is a Wolf-Rayet star, a short-lived phase in the evolution of massive, luminous stars. The star probably started off with about 35 solar masses, but it has shed so much material that it probably now contains only about 12 solar masses. It is destined to go supernova in about 100,000 years.

Seize the Night!
ORION
Our 25th Year!

ORION
TELESCOPES & BINOCULARS

Everything for the Amateur Astronomer

Orion®
ShortTube™ 80 EQ
Only $289

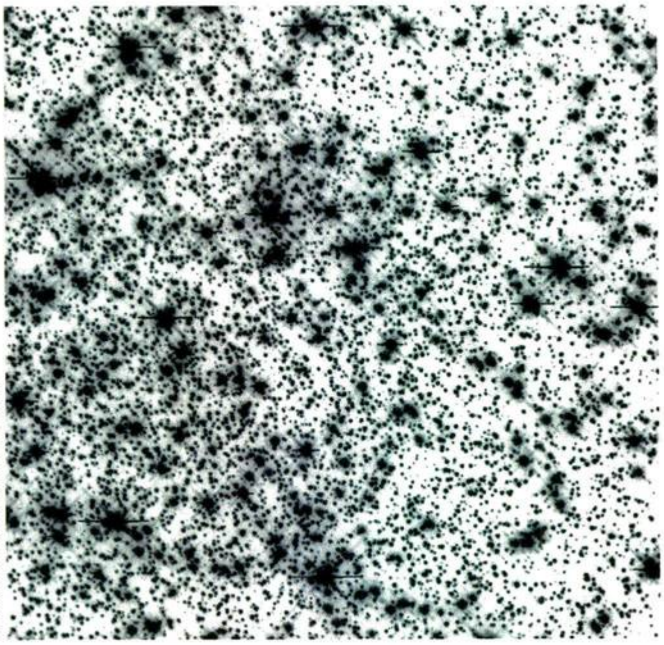
When ordering,
mention key code,
TMA000,

ORION
25th Anniversary Specials
www.telescope.com

FREE 100-PAGE CATALOG
Call toll-free (800) 447-1001

Selected Orion products are also available
at authorized astronomical dealers.

telescope.com



Ronald Gilliland (STScI), et al., and NASA

Cerro Tololo Inter-American Observatory

Top: The Hubble Space Telescope resolves thousands of individual stars in globular cluster 47 Tucanae. But none of the stars show the characteristic dimming caused by transiting planets. Above: A ground-based image captures the glory of 47 Tuc.

"A remarkable conclusion is emerging," says University of California at Berkeley astronomer Geoff Marcy, coleader of the team that has discovered the most extrasolar planets. "Stars with few heavy elements are planet poor. And stars with abundant precious metals are abuzz with planets, probably including rocky ones the size of Earth."

— Robert Naeye

HEART OF THE GALAXY

It's Raining Deuterium

▶ Did they say rain? Awash with gas clouds and deuterium showers, the latest results from the National Radio Astronomy Observatory's 12-meter radio telescope atop Kitt Peak, Arizona, are reminiscent of a weather forecast.

In the June 29 *Nature*, a team of astronomers led by Donald Lubowich of Hofstra University and Jay Pasachoff of Williams College reported the detection of unexpectedly large quantities of deuterium in Sagittarius A, a giant gas and dust cloud near the galactic center.

The astronomers report that the torrent of deuterium, a rare isotope of hydrogen with one neutron accompanying the usually lone proton, appears to be raining onto the center of the galaxy from outside the disk. "All the evidence tells you that there probably has to be an external source of deuterium," says Lubowich.

Current understanding of the formation of light elements suggests that most, if not all, of the deuterium in the universe was created just minutes after the Big Bang. Measuring deuterium abundances allows astronomers to test models of temperature and density conditions in the early universe.

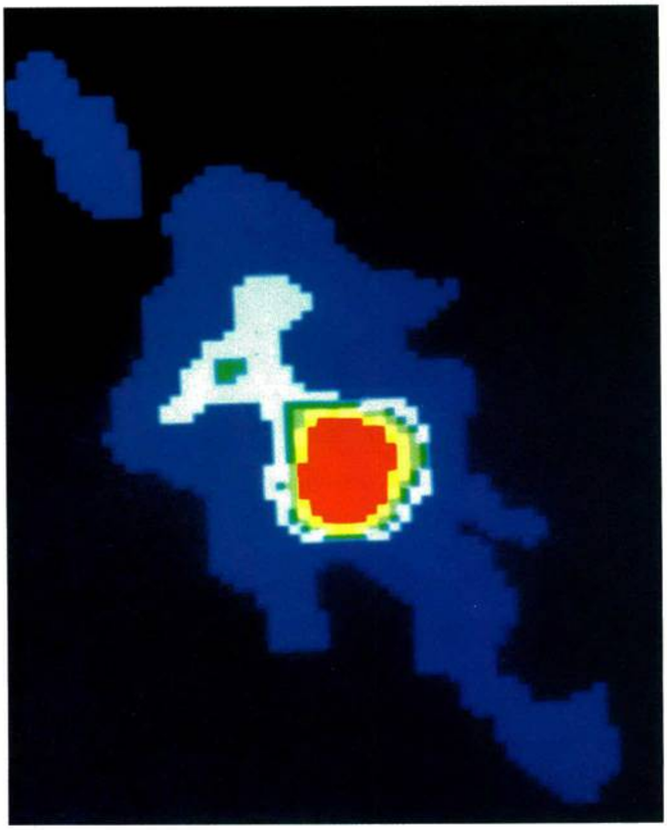
Deuterium and other light elements are destroyed in stellar thermonuclear reactions that create helium and heavy elements, such as carbon and nitrogen. As stars form and die, the amount of deuterium in the galaxy should continually decrease, especially near the highly active galactic center.

In the absence of local processes capable of producing deuterium in the galactic center, chemical evolution models predict that the ratio of deuterium to normal hydrogen should be very low — less than one atom of deuterium per one trillion hydrogen atoms. But this latest radio survey of the galactic center has detected nearly one million times the expected amount of deuterium.

This 12 meter (39 foot) radio telescope at Kitt Peak, Arizona, discovered large quantities of deuterium in the galactic center.

Donald Lubowich (Hofstra University)

An earlier radio image from the Very Large Array (VLA) shows the center of the Milky Way Galaxy. Sagittarius A covers the area in red.



Donald Lubowich (Hofstra University), et al., VLA, NRAO

One Universe

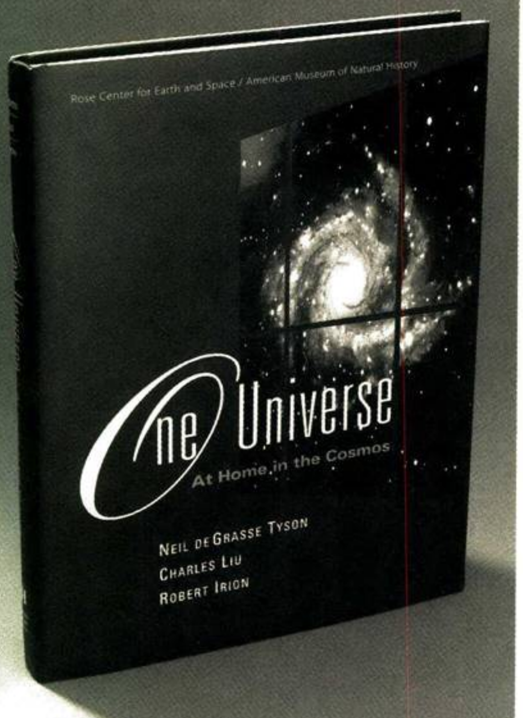
At Home in the Cosmos

Neil de Grasse Tyson
Charles Liu
Robert Irion

Published by
Joseph Henry Press
Washington DC
in conjunction with the
Rose Center for Earth and Space
American Museum of Natural History

ISBN 0-309-06488-0
224 pages. More than 200 full-color photographs and original illustrations.
$40.00

www.jhpress.org
Available at bookstores everywhere.



The vastness and the mystery of the universe brought down to Earth.

a new millennium!
time to be on time ....
.... atomic time!

with the world's most accurate time pieces, atomic clocks & watches from

ATOMIC TIME

- reliable convenient time pieces
- synchronized to the u.s. atomic clock, Fort Collins/CO
- accurate to 1 second in 1 million years
- engineered in Germany
- radio-controlled time

choose from our wide variety: casual & sport watches
travel alarms • wall clocks
desk clocks • wood clocks
radios • weather stations
computer UTC clocks
industrial & commercial clocks

20% off second item

call for our free brochure:
(630) 472-9999
or go to www.atomictime.com
credit card orders call toll-free
1-800-985-8463
send checks/money orders for the total amount incl. s&h $7.00 to

ATOMIC TIME, INC.
1010 JORIE BLVD., #332
OAK BROOK, IL 60523

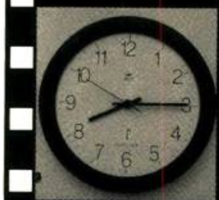
synctime metallic mesh band, metal bezel mineral lens, hi-tech polymer case $179.95

atomic radio with 2 alarms and temperature, day, date, LCD $59.95

atomic digital alarm sport watch 2nd UTC 24hr time display, lap etc. • $99.95

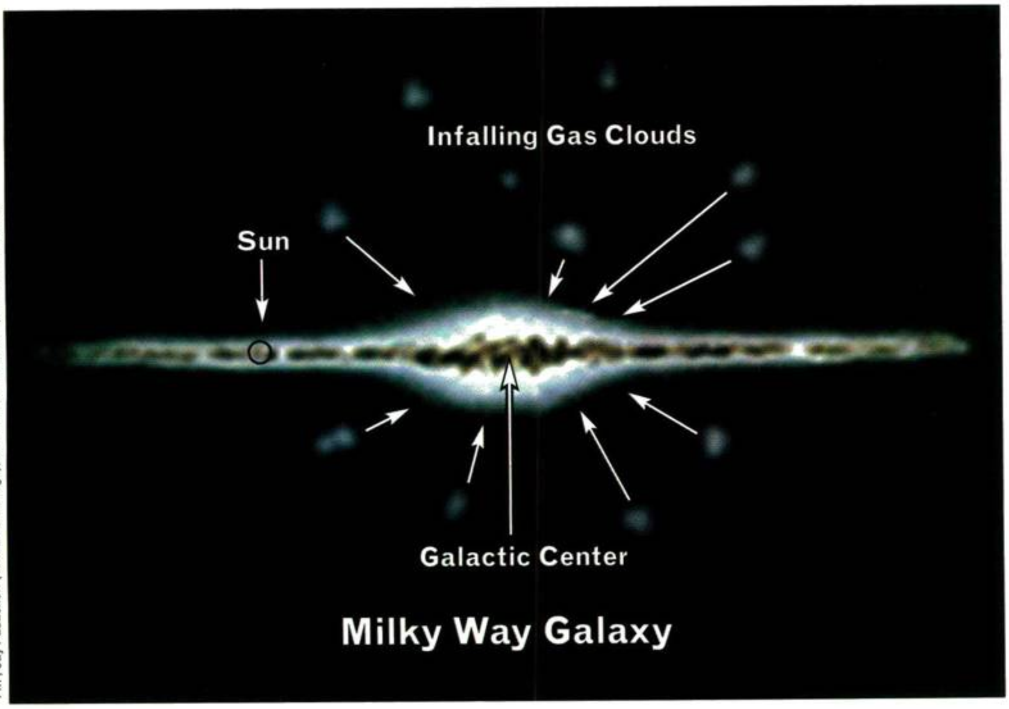
atomic dual alarm clock w. 2nd world time, 5x4x21/2" black arch design $59.95

jumbo digit atomic clock w. temperature & humidity, wall or desk 8"x11"x1" • $79.95


black Arabic 12" wall clock for home or office • $69.95 (wood $89.95)

www.StarSafaris.com

Over 200 pages of telescopes, eyepieces and resources.



AIP, Jay Pasachoff (Williams College), and Donald Lubowich (Hofstra University)

Gas clouds containing deuterium appear to be falling toward the galactic center from the halo.

Previous investigations didn't detect evidence for other light elements in the galactic center. This supports the idea that the deuterium in Sagittarius A was not manufactured locally. "You wouldn't create only deuterium through local processes. We would see different amounts of lithium and beryllium too," explains Pasachoff.

The team's analysis reveals that the deuterium is likely 10 billion to 12 billion years old, but has only recently — within the last 10 million years or so — traveled to the galactic center. "We have evidence for old material, either from the Big Bang or from which the Milky Way formed, falling onto the galactic center," says Lubowich.

These results, coupled with recent observations of high-velocity clouds of diffuse gas falling from the Milky Way's halo, may help astronomers understand the formation and evolution of our galaxy, as well as how much of the universe is composed of ordinary matter. — William Schomaker

MICROQUASARS

New Beast in the Galaxy

▶ They're rude, they're violent, and thankfully there are none close to us. These objects are microquasars, so-called because they are scaled-down versions of their more powerful brethren that lurk in the hearts of distant galaxies.

But the discovery of a new microquasar called LS 5039 suggests that there is a kinder, gentler variety of microquasar, one that is much more difficult to detect. If there are other microquasars out there like LS 5039, the galaxy could be littered with hundreds of these enigmatic objects.

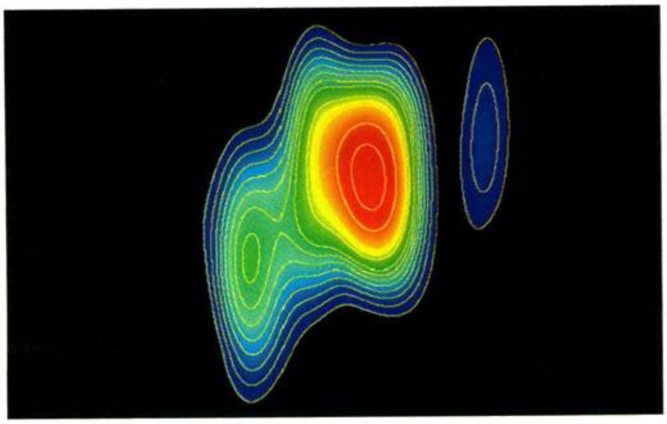
Microquasars are binary systems consisting of a normal star and either a black hole or neutron star. As the black hole or neutron star accretes gas from its stellar companion, it funnels some of the material into a pair of laser-like jets that shoots away from the collapsed object in opposite directions at speeds approaching that of light. The 10 previously known microquasars called attention to themselves through occasional outbursts of x rays and radio waves.

But LS 5039 is genteel in comparison; so far it hasn't produced a single observed outburst. In visible light, the source is an unremarkable magnitude 11, O-type star about 10,000 light-years away in Scutum.

Josep Paredes of the University of Barcelona in Spain and three colleagues suspected it might be a microquasar after they checked a catalog of radio sources and found that LS 5039 was a strong radio emitter. Intrigued, they aimed a network of radio telescopes in Hawaii, the Virgin Islands, and across North America at LS 5039. By using radio telescopes separated by large distances, a technique called interferometry, Paredes and his colleagues could resolve tiny structures just a few milliarcseconds across.

The high resolution radio images revealed two jets of subatomic particles shooting away from LS 5039 at speeds of at least 15 percent that of light. The jets are similar to those emanating from other microquasars. "This is what we were looking for to con-

This high-resolution radio image shows twin jets of subatomic particles shooting away at high speed from a black hole or neutron star.



Josep Parades (Univ. of Barcelona), et al., and *Nature*

CASSIOPEIA
File View Data Tools
Powered by Microsoft Windows CE
Palm-size PC
Aquila
Vulpecula
Sagitta
Scutum
Lyra
Hercules
Draco
Ophiuchus
Corona Borealis
Serpens
Bootes
Canes V
F:100°00' RA:16h 36m Dec:+19°50' 5:20 pm 11/25/99
Start
3:05p
CASIO

Honey, I shrunk the universe.

It's like having the heavens in the palm of your hand – for only $49.

Introducing TheSky Pocket Edition™ Astronomy Software.

Far more than a quick and accessible field reference tool, it's the leading deep-space software and desktop computing power condensed in a portable planetarium.

TheSky Pocket Edition is also direct goto-telescope control, just like your PC.

Now anybody, anywhere can harness deep-sky goto technology simply, from a Palm-size or Handheld PC.

So, roll up the star charts, shut off the old L.E.D., and hang up the hand paddle. This powerful tool can be yours now by ordering at our website.

TheSky Pocket Edition is the newest big idea from Software Bisque.

Palm-size utility – like carrying the heavens in a thimble.

THESKY™ VERSION 5
Astronomy Software
1.800.843.7599

Powered by Microsoft® Windows® CE

SOFTWARE BISQUE

SOFTWARE BISQUE 912 TWELFTH STREET GOLDEN, COLORADO 80401 FAX: 303.278.0045 PHONE: 303.278.4478

THESKY POCKET EDITION IS A TRADEMARK OF SOFTWARE BISQUE, INC. WINDOWS IS A REGISTERED TRADEMARK OF MICROSOFT CORPORATION. THESKY POCKET EDITION - $49, PALM-SIZE PC NOT INCLUDED.

THESKY POCKET EDITION REQUIRES MICROSOFT WINDOWS CE, VERSION 2.11 OR LATER FOR THE PALM-SIZE PC AND WINDOWS CE, HANDHELD PC PROFESSIONAL EDITION SOFTWARE, VERSION 3.0 OR LATER FOR THE HANDHELD PC.

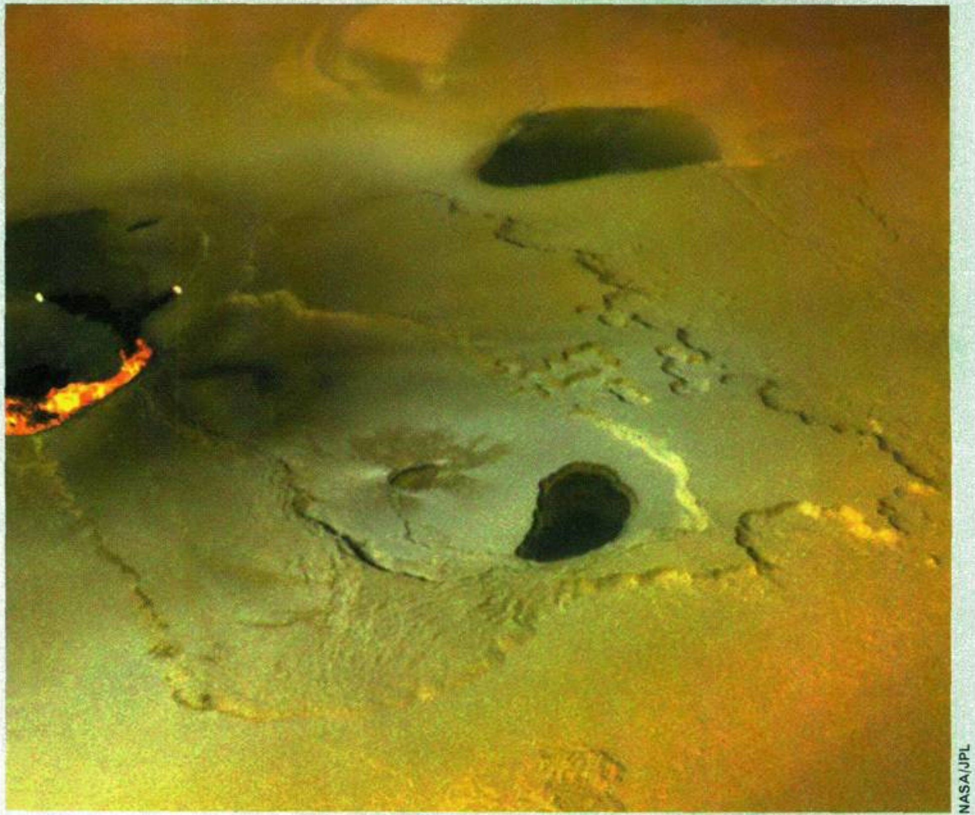
bisque.com

firm the suspected microquasar nature of this source," says Paredes, who published the findings in the June 30, 2000, *Science.*

The team recently perused a catalog of gamma-ray sources seen by the Compton Gamma-Ray Observatory's EGRET instrument. EGRET revealed that a continuous stream of high-energy gamma rays is coming from the direction of LS 5039. EGRET found nearly 100 mysterious gamma ray sources near the galactic plane similar to LS 5039. It's quite possible that under closer scrutiny some of these sources will also turn out to be microquasars.

"The relatively unspectacular nature of the source at optical and x-ray wavelengths indicates that it may be just one of a large population of such objects that have been previously overlooked," writes Rob Fender of the University of Amsterdam in the same issue of *Science.* — R. N.

GALILEO MISSION



NASA/JPL

DON'T BLINK **or you might miss something on Jupiter's volcanic moon Io. The Galileo spacecraft beamed back this view of Tvashtar Catena — a chain of giant volcanic calderas — taken during its most recent close flyby of Io on February 22. Surprisingly, the region looked totally different than it did in an image from just three months earlier. Back in November 1999, the dark, L-shaped lava flow seen to the left of center in this false-color image was the site of an energetic eruption. By February, this region had cooled and lava was erupting farther to the west (far left). The orange and yellow ribbon highlights an extremely hot lava flow roughly 40 miles (60 km) long. These and other images suggest that some of Io's smaller, fainter volcanoes turn on and off within a few weeks while larger ones remain active for years or decades.**

BROWN DWARFS

The Mouse That Roared

► For 9 hours and 36 minutes, Chandra saw nothing. That was exactly what astronomers expected when they pointed the x-ray observatory at a brown dwarf known as LP 944-20 on December 15, 1999.

Then wham, suddenly LP 944-20 sprang to life, generating a flare that was visible to Chandra for two hours. "We were shocked," admits Caltech astronomer Robert Rutledge. "We didn't expect to see any flaring from such a lightweight object. This is really the mouse that roared."

"It wouldn't be a big deal on the sun," adds team leader Gibor Basri of the University of California at Berkeley, noting that the flare was comparable to a low-level solar flare. "But the brown dwarf's luminosity is so small compared to the sun, about 1/10,000, that it's a big deal there."

Basri's team selected LP 944-20 as a Chandra target because it is the closest known brown dwarf, lying 16 light-years away in Fornax. Astronomers estimate that it contains at most 60 times the mass of Jupiter and is about 500 million years old, meaning it has had plenty of time to cool since it formed.

Team members were observing LP 944-20 to eliminate the possibility that relatively old brown dwarfs have coronae, or hot outer atmospheres. Stellar coronae emit a continuous stream of x rays that Chandra can easily detect 16 light-years away. Because the brown dwarf was quiescent for most of Chandra's 12-hour observation, the team was right — LP 944-20 probably isn't generating enough energy to sustain a corona.

Africa Eclipse Expedition

Join Eclipse Edge Expeditions June 14-22, 2001 as we explore Victoria Falls, Zimbabwe. Itinerary includes animal safari and best view of the total solar eclipse -- from near the path edge, where more and longer totality phenomena are seen.

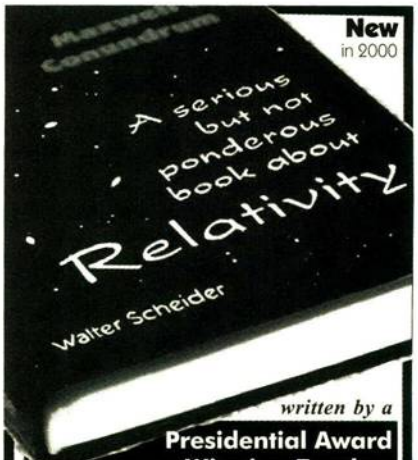
Run by professional astronomers; our experienced team has selected sites to maximize weather prospects and will have mobility available if needed. Astronomy program includes southern sky observing. Optional activities include white water rafting, bungee jumping, elephant ride; and tethered balloon or helicopter view of the falls.

From $1750
short program originating
in Johannesburg

To $3900
full program, air from
Washington, DC

Eclipse Edge Expeditions 'Z01
P.O. Box 15186
Chevy Chase, MD 20825-5186
800-898-3343 (recording)
http://metaresearch.org/edge

New
in 2000



written by a

Presidential Award Winning Teacher

- **"Highly recommended"**
  -- ALA's CHOICE Magazine, Sept 2000
- **"marvelously well written"**
- "for the first time, a book on relativity both **rigorous and readable"**
- **"clear and engaging style"**
- uses introductory level algebra

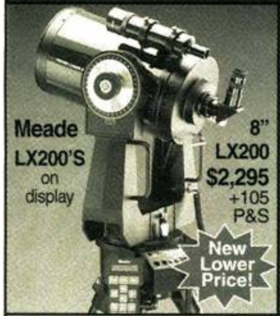
FOR TEACHERS! **A problem set, with solutions. Info at 734-663-3846**

Cloth $22.95 Paper $14.95 1-800-247-6553
Cavendish Press POBox 2588 Ann Arbor MI 48106
www.cavendishscience.org

Rivers CAMERA SHOP

"Call for our informative catalog"

AUTHORIZED MEADE® APD MAIL-ORDER DEALER



Meade
DS-127EC
$499.95
+30 P&S

Meade
ETX-90/EC
$595.00
+20 P&S

ETX Accessories
#126 2x Barlow $47.95
#64 Camera Adapter
$34.95
ETX Tripod $199.95

Most Meade Products In Stock/On Display!

- Meade Starfinder
- Dobsonians & Equatorials
- Meade LX50's
- DS70, DS80, DS90, DS114, DS127
- Meade Series 3000 and 4000 Eyepieces
- Most other Meade accessories in stock

AUTHORIZED CELESTRON® DEALER

NEW Nexstar 5
in stock
$1199.95
+20 P&S

New
CELESTRON
Nexstar 8 inch
Including Tripod
$1899.95
+30 P&S

Most Celestron Products In Stock!

- Celestron Star Hopper Dobsonians
- Celestar 8 SCT's
- LED flashlights
- Ultima Series Eyepieces
- First Scope 60's, 70's, 80's & 114's in stock
- Accessories in stock

Collins Image Intensifier
In stock
See what you have been missing!

New Location!
179 Water Street
Exeter, NH
(603) 778-1990

Why Buy From Us?

NE's Largest Telescope Display

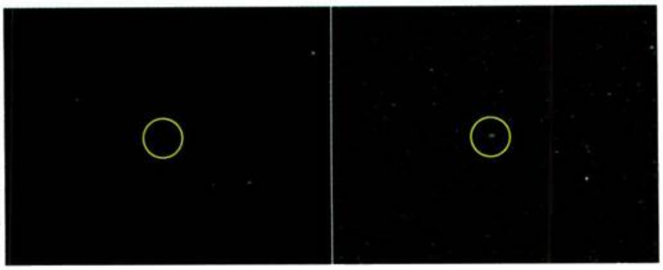
Mail-Order or In-Store. No Sales Tax!

Used Scopes-Buy, Sell or Trade-In

Knowledgeable, Helpful, Friendly Staff

TeleVue®

Rivers CAMERA SHOP
454 Central Ave.
Dover, NH 03820
Phone: (800) 245-7963 • Fax: (603) 742-5456
Hours: M-TH 8:30-6:00, Fri. 8:30-8:00, Sat. 8:30-5:30
www.riverscamera.com



NASA/UCB/Caltech/R. Rutledge, et al.

These images were taken 8 hours apart by the Chandra X-ray Observatory on December 15, 1999. In the left image, the brown dwarf LP 944-20 is quiescent. On the right, the brown dwarf flared to life.

But astronomers now have to explain how a cool, substellar object can produce a flare. "We really don't know how you can have flares if you don't have a corona," says Basri. He speculates that the flare was generated about 60 miles below the brown dwarf's visible surface, where gas would be hot, turbulent, and highly magnetized. "A subsurface flare could heat the atmosphere, allowing currents to flow and give rise to an x-ray flare, like a stroke of lightning," he says.

Even if brown dwarfs are cool, inert objects, Adam Burgasser of Caltech notes, "The x rays show that these things aren't just quiet little balls of contracting gas, they have some kick in them!" — R. N.

JUPITER

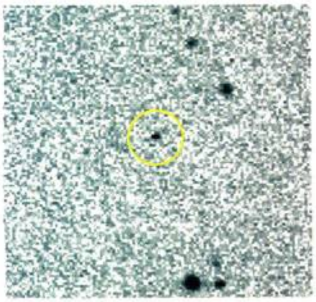
Mini-Moon

▶ Astronomers may have to dust off the Jupiter family album. Since 1974, the number of satellites circling the giant planet has held steady at 16. But an object previously thought to be an asteroid has made its case for moon-hood.

Jeff Larsen, Robert McMillan, and their colleagues from the University of Arizona's Spacewatch Project imaged the space rock, called 1999UX$_{18}$, last fall with a 36-inch telescope on Kitt Peak in Arizona. But just recently, Tim Spahr, Gareth Williams, and Brian Marsden of the Minor Planet Center in Cambridge, Massachusetts, analyzed the Spacewatch images to calculate an orbit for the approximately three-mile-wide rock. They found that the object, now called S/1999 J1, appears to be orbiting Jupiter every two Earth-years at a distance of about 15 million miles. The moon orbits in a direction opposite of the planet's rotation, meaning it is probably a captured asteroid.

As its orbit is refined with subsequent observations, S/1999 J1 will be granted the status of 17th moon of Jupiter. It is the smallest known satellite of all the planets. — W. S.

S/1999 J1 is Jupiter's 17th known moon and the first discovered since 1974. Jeff Larsen, Robert McMillan (University of Arizona), et al.



The Whole Sky at Your Fingertips

Wouldn't it be cool to see things in a whole new light? Superman used his infrared vision to thwart villains and navigate through the dark. And now, astronomers are using theirs to give the public an unprecedented view of the night sky. The Two-Micron All Sky Survey (2MASS), a collaboration between the University of Massachusetts at Amherst, NASA, and Caltech, has publicly released 1.9 million images from its infrared all-sky survey that began in 1997. Using twin 1.3 meter telescopes in Arizona and Chile, the 2MASS team has discovered brown dwarfs, galaxies, and dust-obscured quasars. Images are available at www.ipac.caltech.edu/2mass/gallery/.

2MASS/Univ. of Massachusetts/Caltech/IPAC

The Flame Nebula (NGC 2024) as seen by 2MASS.

Rocket Launch Boosts Pizza Sales?

On July 12, NASA officials were beaming with delight as the $320-million Zvezda, the newest International Space Station module, blasted off from Baikonur Cosmodrome in a Russian Proton rocket. Pizza Hut executives were beaming too. The rocket sported the company logo — a deal which reportedly cost the pie makers $1 million. The launch of the Russian-built module marks a milestone in the construction of the station, which is expected to cost $60 billion and weigh 480 tons when complete. On July 25, Zvezda docked successfully with two modules that have been in orbit since 1998. The 43-foot-long, 22-ton module will act as control center for initial stages of the project. Zvezda's launch was delayed more than two years primarily due to economic instability in Russia. The first crew will go up in late October.

NASA Heads Back to Mars

NASA has announced plans to send a new rover — a veritable robotic field geologist — to Mars in 2003. The Mars Geologic Rover (MGR) will employ the drop, bounce, and roll technology of its 1997 Pathfinder predecessor to reach the surface of the Red Planet on January 20, 2004. About three times larger than Pathfinder's rover Sojourner, the nearly 300-pound (135-kg) rover will spend 90 martian days (about 92 Earth days) examining rocks and searching for evidence of liquid water that might have existed in the planet's recent geologic past. "The MGR will provide images of clarity and crispness like we have never seen. It will be like being there in person," says Jim Bell of Cornell University, scientific leader for the rover's panoramic camera. NASA selected the rover instead of a proposed Mars orbiter.

The Universe Is Full of Mysteries. Using NexStar™ Isn't One of Them.

The joy of stargazing comes from observing the wonders of the heavens, not calculating alignments and positioning. The revolutionary new Celestron NexStar 5 does all that for you and more. Simply and easily.

NexStar 5 is light years ahead of other computerized GOTO telescopes, with Auto Align to get you up and observing immediately and an enormous object data base that includes more than 18,000 celestial sights.

Our Star Pointer Finderscope lets you quickly find any object in the sky, while variable slew speeds provide easy tracking for observation and astrophotography. You can attach our Hand Controller to the telescope's unique fork arm, or hold it for remote operation. There's even a communication port so you can control the NexStar 5 from your computer.

NexStar 5 is designed to go with you anywhere and perform beautifully. The legendary 5" Schmidt-Cassegrain optical system with Starbright® multicoatings guarantee superb views. Best of all, our Tour Function automatically seeks out the most spectacular objects in a given month, while providing you with fascinating facts through the Hand Controller.

If you're looking for a telescope that makes astronomy pure joy and fun, there's no mystery about which one to choose. **Celestron's NexStar 5.**

CELESTRON®

Find out more about NexStar 5, our other exceptional telescopes,
and nearby dealers. www.celestron.com

2835 COLUMBIA STREET • TORRANCE, CA 90503 • (310) 328-9560 • FAX (310) 212-5835

exploration destination

Just because you favor dark skies doesn't mean you should be in the dark when it comes to shopping for Astronomy gear. At eHobbies you will find everything you need for your next star party, including telescopes and accessories, binoculars, star charts, books and software. Whether you're a backyard astronomer or an expert looking for the next great celestial discovery, our unparalleled customer service will save you enough time to tackle the Messier marathon.

scope scoop

eHobbies provides astronomers with a solar mass of information about their craft. Articles by the experts, tips and reviews, an event calendar and a star chart can all be found in **eH Magazine.**

celestial conversation

Discuss the latest astronomical discoveries or let others know about your latest sighting. It's easy with the message boards and chat rooms in the **eH Communities.**

streaming stars

Get an up close look at our planetary neighbors or see asteroids and comets in motion. The sights and sounds of the universe can be found on the astronomy channel on **eHTV.**

big bang bidding

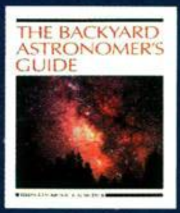
It's never been so easy to spot bargains on astronomy products. Name your price on books, software and accessories or get a scope for a steal at **eH Auctions.**

free shipping!

for all orders over $100

SKU# 1003-9772 ▸
8" NexStar Telescope
by CELESTRON
eHobbies price: $1,899.99

◂ SKU# 1004-1472
2x 1.25" Ultima Barlow Lens
by CELESTRON
eHobbies price: $69.99



◂ SKU# 1004-3443
The Backyard Astronomer's Guide
by SKY PUBLISHING CORP.
eHobbies price: $39.99

SKU# 1004-3430 ▸
Advanced Skywatching
by SKY PUBLISHING CORP.
eHobbies price: $29.99

SKU# 1004-2155 ▸
8x56 Victory Series Binocular w/Pouch
by ZEISS OPTICAL
eHobbies price: $1,279.99

◂ SKU# 1004-1202
7x50 Enduro Series Binocular
by CELESTRON
eHobbies price: $44.99

◂ SKU# 1004-1218
10x50 Ultima Series Binocular
by CELESTRON
eHobbies price: $239.99

SKU# 1004-1286 ▸
Firstscope 114 Premium Telescope
by CELESTRON
eHobbies price: $349.99

SKU# 1004-3529 ▸
Nightwatch: A Practical Guide To Viewing
by SKY PUBLISHING CORP.
eHobbies price: $29.99

◂ SKU# 1004-3449
Burnham's Celestial Handbook, Volume 3
by SKY PUBLISHING CORP.
eHobbies price: $14.99

◂ SKU# 1004-1128
Star Hopper 4 1/2 Telescope
by CELESTRON
eHobbies price: $193.99

SKU# 1003-9769 ▸
C102-HD Refractor Telescope
by CELESTRON
eHobbies price: $499.99

SKU# 1004-2441 ▸
G - 8 Schmidt-Cassegrain
by CELESTRON
eHobbies price: $999.99

Log onto our website for our entire selection and current prices.

check out our full selection online at www.eHobbies.com
or call our toll-free number, 24 hours a day, 7 days a week to order by phone

1-888-eHobbies

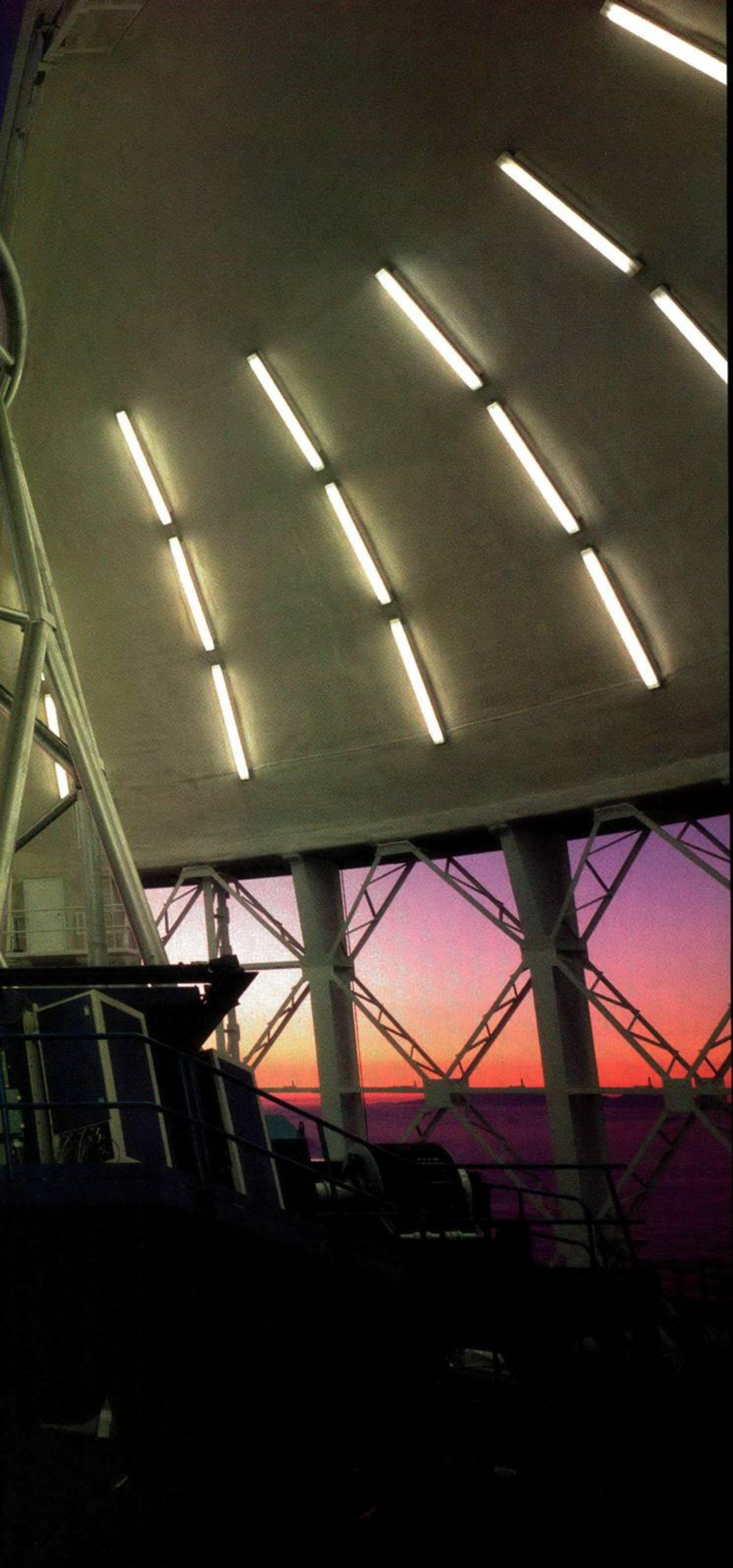
eHobbies℠

AOL Keyword: eHobbies

creating a new world for hobbyists℠

AST_0006

© 2000 eHobbies.com, Inc. All rights reserved.
The eHobbies logo and "creating a new world for hobbyists" are servicemarks of eHobbies.com, Inc.



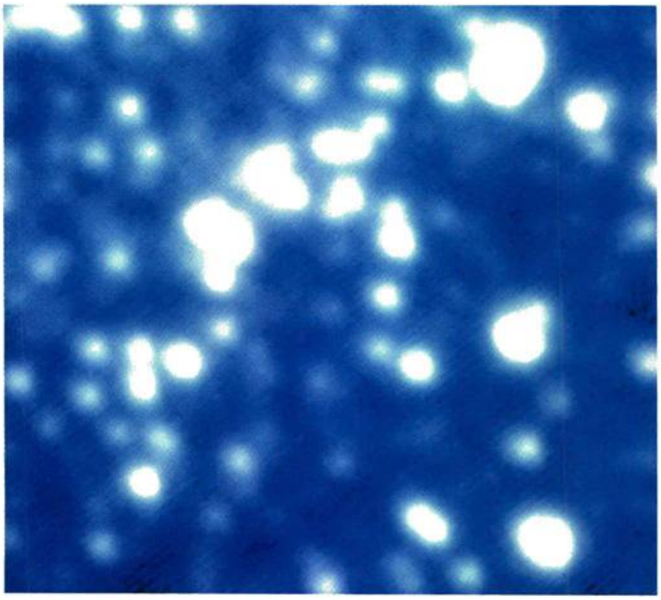
HIGH-TECH TWIN TOWERS

The Gemini telescopes will take infrared astronomy to new heights.

by Rex Graham

Greek mythology says Zeus created the constellation Gemini to honor his twin sons Castor and Pollux, warriors noted for their devotion to each other. In a nod to astronomy's mythic roots, seven nations are spending $184 million to build the Gemini Observatory, twin 8.1-meter telescopes that together will reign over the whole sky. Located on the summits of Hawaii's Mauna Kea (Gemini North) and Cerro Pachón in central Chile (Gemini South), the scopes bristle with state-of-the-art technology and lofty expectations.

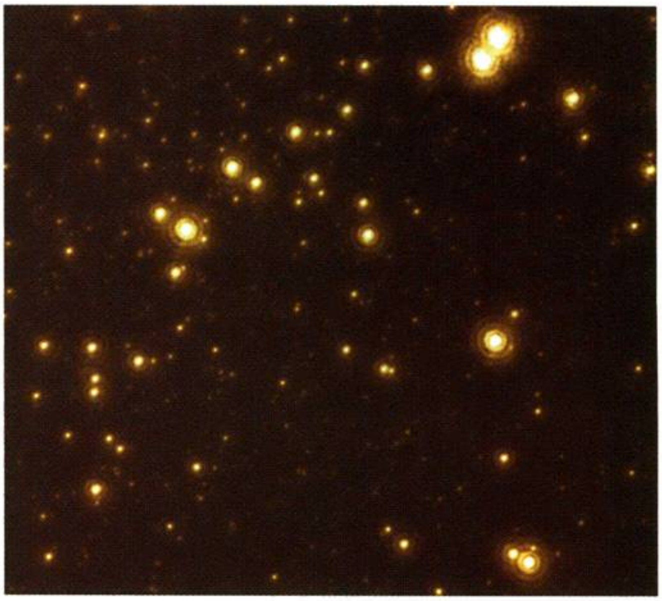
The telescopes' arid, chilly perches — 13,824 feet at Mauna Kea and 8,895 feet at Cerro Pachón — are optimal positions for ground-based optical and infrared astronomy. The first test images from Gemini North, taken in March 1999, were so sharp that they blur the distinction between ground- and space-based



Above: Without adaptive optics, the atmosphere blurs the stars in the center of globular cluster NGC 6934 into a mishmash of blobs.

Gemini Observatory/NSF/University of Hawaii Institute for Astronomy

Previous page: Because the telescope rides on a thin layer of oil, the interior of Gemini North is remarkably quiet. Neelon Crawford/Polar Fine Arts



Above: Using adaptive optics, Gemini North can easily resolve NGC 6934's stars so that each one can be studied individually.

Gemini Observatory/NSF/University of Hawaii Institute for Astronomy

Right: The 8.1-meter Gemini mirrors are among the largest single-piece telescope mirrors in the world. Gemini Observatory/Peter Michaud

telescopes. Indeed, Gemini North's first infrared images had 0.08-arcsecond resolution, which is slightly better than optical images taken by the Hubble Space Telescope. This is comparable to resolving the two headlights of an automobile 2,000 miles (3,200 km) away.

With seven partners — the United States, United Kingdom, Canada, Australia, Chile, Brazil, and Argentina — the Gemini Project is a linguistic Tower of Babel. But astronomers have spoken with one voice about their need for large telescopes. "These telescopes have an international mission and in that way they are like the International Space Station," says Gemini Observatory director Matt Mountain. "There is a tremendous will within the scientific community for this project."

The 10-meter Keck I and II telescopes, which are within a volcanic stone's throw of Gemini North, are the most powerful optical and infrared telescopes on the planet. But usage of the Kecks is primarily limited to California Institute of Technology and University of California astronomers. The participating nations established the Gemini Project in 1991 so all of their astronomers would have access to large telescopes in both the Northern and Southern Hemispheres.

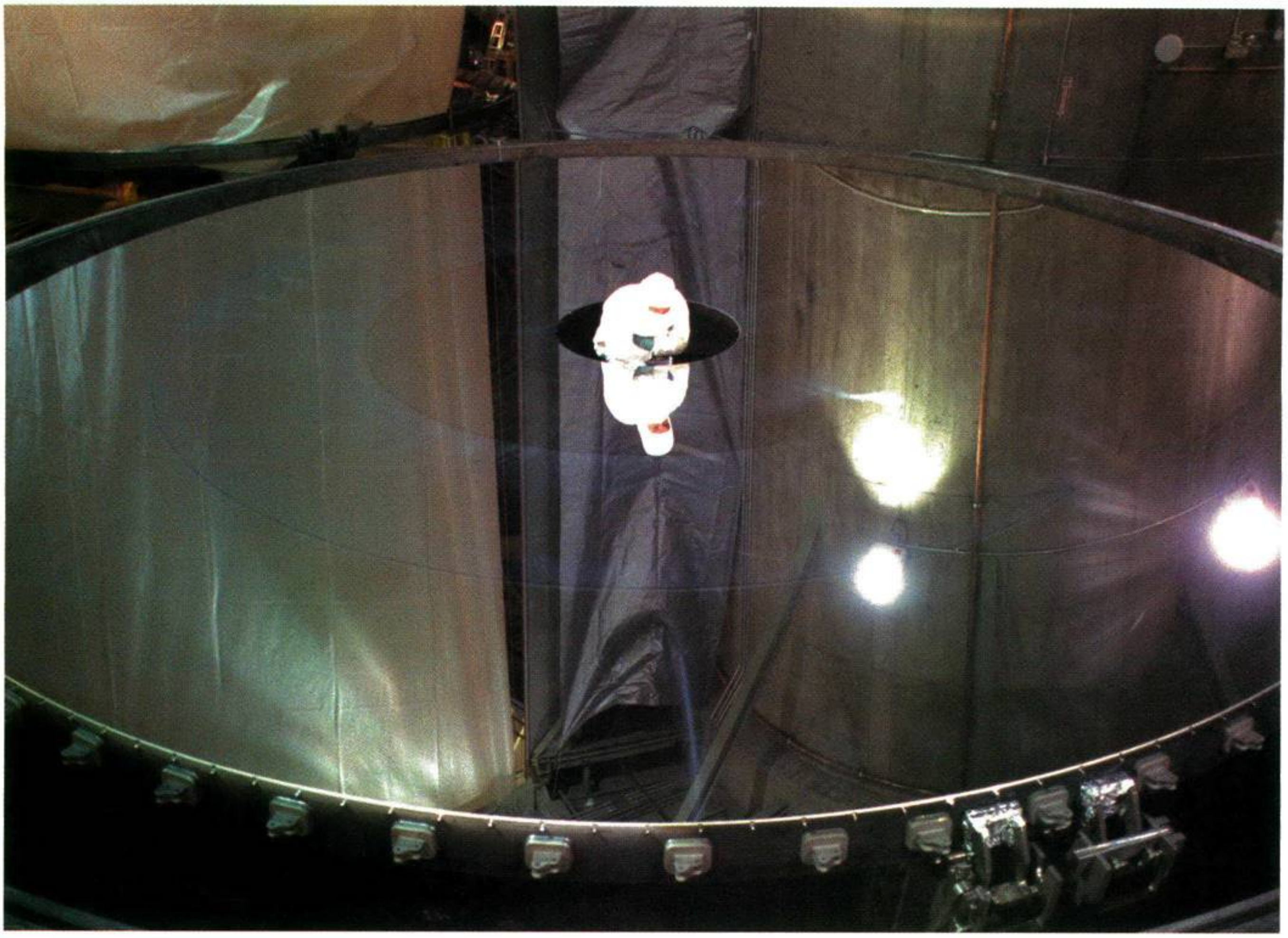
Gemini North's science observations have recently begun. Gemini South is in the final stages of construction. Its mirror arrived on March 17, 2000, and first light is scheduled for later this year. The mirror was fabricated by Corning in New York State, polished in Paris, shipped through the Panama Canal, and trucked up a narrow mountain road. "It is never easy to move something this big, awkward, and delicate," says Gemini Project Manager Jim Oschmann. "We even had to widen one of the tunnels so that the mirror and other parts of the telescope could get through."

Gemini South recently passed its "first oil" milestone, an insider's term for the first time the 377-ton telescope was suspended on its bearing. A thin layer of oil supports each of the Gemini telescopes, rendering them eerily quiet as they slew across the heavens. Both telescopes will remain works in progress, designed to capitalize on the latest advances in detectors and imagers. The telescopes also have a built-in active-optics system to maintain the optimal curvature of the primary mirrors and an adaptive-optics system that will remove image distortions caused by atmospheric disturbances.

Unfortunately, every telescope, including the Gemini telescopes, has tiny inherent errors that degrade image quality: imperfect mirror polishing, flexing of the telescope support structure, and gravitationally induced deformations. In order to overcome those errors, each Gemini primary mirror is 8 inches (20 cm) thick — thick enough to support its weight, but thin enough to flex and bend ever so slightly.

Each primary mirror rests on a bed of 120 actuators — circular supports the size of coffee cups that individually move the primary mirror up and down between $\frac{1}{10{,}000}$ and $\frac{1}{1{,}000}$ the width of a human hair. The actuators' minute adjustments alter the curvature of each mirror to ensure that it holds its correct shape. Another 60 actuators press against the edge of each mirror and move equally small distances to maintain the mirror's exact curvature when astronomers tilt the telescope toward the horizon. The active-optics system is so precise that image resolution is limited only by the distortions caused by Earth's atmosphere. Another technology — the adaptive-optics system — removes those distortions.

Light from distant stars, galaxies, and other objects reaches Earth like perfectly straight ocean waves continually washing ashore one after another. However, when light passes through the atmosphere, denser regions of the atmosphere slow light waves more than less-dense regions. For this reason, the light waves encountering a large mirror are not perfectly straight. They are distorted. The Gemini telescopes will combat these distortions with adaptive-optics systems, one being developed at the University of Hawaii, and another at the Herzberg Institute of Astrophysics in Canada. With such technology, telescopes as big as Gemini can achieve their theoretical resolution limits.



THE WORLD'S LARGEST OPTICAL TELESCOPES

Name	Effective Aperture (meters)	Location	First Light
In Operation			
Keck I*	10.0	Mauna Kea, Hawaii	1990
Keck II*	10.0	Mauna Kea, Hawaii	1996
Hobby-Eberly	9.2	Mt. Fowlkes, Texas	1996
Subaru	8.3	Mauna Kea, Hawaii	1999
Very Large Telescope: Antu*	8.2	Cerro Paranal, Chile	1998
Very Large Telescope: Keuyen*	8.2	Cerro Paranal, Chile	1999
Very Large Telescope: Melipal*	8.2	Cerro Paranal, Chile	2000
Very Large Telescope: Yepun*	8.2	Cerro Paranal, Chile	2000
Gemini North	8.1	Mauna Kea, Hawaii	2000
MMT	6.5	Mt. Hopkins, Arizona	2000
Magellan I*	6.5	Las Campanas, Chile	2000

Name	Effective Aperture (meters)	Location	Estimated First Light
Under Construction			
Gran Telescopio Canarias	10.4	La Palma, Canary Islands	2002
Southern Africa Large Telescope	9.1	Sutherland, South Africa	2004
Large Binocular Telescope, Mirror 1*	8.4	Mt. Graham, Arizona	2003
Large Binocular Telescope, Mirror 2*	8.4	Mt. Graham, Arizona	2004
Gemini South	8.1	Cerro Pachón, Chile	2000
Magellan II*	6.5	Las Campanas, Chile	2002

*Signals from two or more telescopes will be combined as interferometers to achieve extremely high resolution.

INGENIERIA DE TRASPORTES
JAVIER CORTES

Gemini South's 8.1-meter mirror was trucked up a narrow, winding mountain road in the Chilean Andes. Gemini Observatory/Peter Michaud

The heart of Gemini's first adaptive-optics system from the University of Hawaii is a flat, 3-inch mirror. The mirror is flexible, changing shape in response to small electrical currents at 36 positions on its back. Light from a star that happens to lie in the same field of view as a distant galaxy or nebula of interest is used as a probe to detect atmospheric disturbances. Light from the guide star is split. It enters a wavefront sensor, which detects where the star's straight wavefronts have been slowed by atmospheric currents. The electrical actuators on the back of the 3-inch mirror electronically push forward the mirror surface to exactly compensate: As a result, the wavefronts from both the guide star and the astronomical object of interest are restored to their original straightness. The whole process works 1,000 times per second, erasing the atmospheric defects in real time. Possibly as early as this year, the Gemini staff will replace the 36-element flexible mirror with an 85-element mirror that will even more precisely correct for atmospheric distortions.

"Every large telescope has implemented, or is close to implementing, such adaptive optics," says University of Arizona astronomer Roger Angel. "When you correct with adaptive optics, you can get images that are quite a bit sharper than Hubble. With adaptive optics you can move into new domains."

Adaptive-optics systems that use natural guide stars have a severe limitation: a relatively bright star — at least 15th magnitude — must be close to the object being studied. That restricts telescopes to 5 percent of the sky at most. The Gemini Observatory plans to install a technology under development that would use natural guide stars together with artificial guide stars. The artificial stars will be created by firing special lasers more than 1,000 times per second at a thin layer of atmospheric sodium 55 miles (90 km) high. The laser light makes sodium atoms release a signature flash of light at a longer wavelength, which is used to make adaptive-optics corrections. The Gemini telescopes plan to install such adaptive-optics systems when they become available in a few years.

In the effort to enhance the signal-to-noise ratio of the Gemini telescopes, engineers have attended to every possible detail. For example, workers treated the domes' exteriors with special reflective-aluminum paint to produce stable thermal environments inside. While both Gemini mirrors have been coated with a layer of reflective aluminum, they will be resurfaced with silver. Why? Silver emits three times less infrared light than aluminum, increasing the signal-to-noise ratio. In addition, a silver mirror reflects 99 percent of infrared light, which is a few percent better than aluminum.

The Gemini telescopes will have cameras and spectrographs sensitive to visible light, but they are optimized for infrared light, which we feel as warmth on our skin. The longer-wavelength infrared light is not as susceptible as visible light to atmospheric distortion. For that reason, telescopes observing at specific infrared wavelengths can produce sharper images than similar-sized optical telescopes. As a result, galaxies and other objects can be studied in finer detail in the infrared, even when each telescope is equipped with similar adaptive optics. Infrared telescopes also can peer deeper into nearby galaxies, including our own Milky Way, because some infrared light passes right through the dust that blocks visible light. This feature will allow Gemini

astronomers to study dust-shrouded newborn stars and the formation of planets around them.

Gemini astronomers have yet another reason for observing infrared light. Visible light emitted by galaxies billions of light-years away doesn't arrive here as visible light. The expansion of the universe redshifts, or stretches, the visible light to longer wavelengths in the infrared part of the spectrum. For this reason, the Gemini telescopes will allow astronomers to study the evolution of stars and galaxies over billions of years.

Astronomers from the participating nations already have swamped the Gemini office with hundreds of requests for telescope time. One of those eager researchers is Harry Teplitz, an astronomer with the National Optical Astronomy Observatories (NOAO). Teplitz and his colleagues currently use smaller telescopes for their research — primarily NOAO's 4-meter Mayall Telescope on Kitt Peak, Arizona, and its twin at the Cerro Tololo Inter-American Observatory in Chile. The tenfold increase in resolving power of the Gemini Observatory over the 4-meter telescopes amounts to a revolution. "For studying cosmology or distant galaxies, you really need a very big telescope, so the Gemini Observatory has that major advantage," says Teplitz. "A lot of the diagnostics by which we understand the physics of nearby galaxies relies on visible light. But to use those diagnostics on things that are very far away, we need to look at visible light that has redshifted to the infrared." ▣

In this composite image, Gemini North rests serenely under the stars near the summit of the volcano Mauna Kea. Gemini Observatory/Peter Michaud

---

Rex Graham is a senior editor for Astronomy.

Cosmic Intrigue

Globular star clusters are helping to pin down the origin of galaxies and the size of the universe.

by Denise Kaisler

If you scan the eastern sky late in the evening this month, you might find a fuzzy, 6th-magnitude "star" between Enif, the star that marks Pegasus's hoof, and the tiny constellation Equuleus. If you do you'll be looking at the globular cluster M15. A moderate-sized telescope trained on M15 resolves a few of its several hundred thousand stars, held in a sphere by their mutual gravity. About 150 known globular clusters inhabit the Milky Way, plunging through its bulge and halo in elliptical orbits far different from the sun's comparatively circular motion in the disk. Some globulars such as NGC 2419 in Lynx, the largest known in the galaxy, contain more than a million stars spread over a diameter of 1,800 light-years.

In the galaxy's disk, massive stars are constantly popping out of open star clusters, going through relatively brief lives, and dying, redistributing their gas and dust throughout the spiral arms. This allows astronomers to see star birth and death in action. Globular clusters present an entirely different picture, however: These groups formed in the earliest days of the galaxy, as clumps and bits of matter gravitated into small spheres far away from the disk. Because of this, the stars in globular clusters are fossil remnants of the infant galaxy — aged, yellow engines floating and fusing their elements at a glacial pace, hardly changed from billions of years ago.

The nature and distribution of globular clusters reveal key facts about the galaxy and the universe to investigating astronomers. The main areas they elucidate include determining the distances to galaxies, the age of the universe, and how galaxies form.

The study of globulars as tracers of the galaxy and universe began long ago: 18th-century British astronomer William Herschel was one of the first to study them. One of his prime targets was the Hercules Cluster (M13), which he studied carefully to reveal the spherical shapes of such star groups. Herschel's observation that most globular clusters lie in the direction of the constellation Sagittarius led his son John to argue that the sun cannot be at the center of the Milky Way. In addition to being spheres themselves, the Milky Way's globular clusters are distributed spherically about the center of our galaxy, extending out through the bulge and into the halo. In fact, astronomers can even determine the sun's distance from the center of the Milky Way by looking at the positions and speeds of globular clusters.

Stars in a single globular cluster not only have similar chemistries, but are nearly equidistant from the sun. This prevents interstellar dimming and reddening — two ways in which the stars' light changes as it travels through space — from posing a problem for astronomers. When observing objects at different distances and in different directions around the sky, dimming and reddening

Globular clusters such as M80 contain hundreds of thousands of stars as old as the galaxy itself. STScI

change significantly from object to object. Not so in a single cluster, as all the stars are dimmed and reddened by the same amount. By sorting the stars in a single globular cluster with respect to magnitude and color, astronomers can determine not only the age of the cluster, but also how an individual star inside it will evolve over time. A graph of this type is called a Hertzsprung-Russell (or HR) diagram, after the early 20th-century astronomers Ejnar Hertzsprung and Henry Norris Russell who invented it. It is the key to understanding and comparing globular clusters, both in the Milky Way and elsewhere.

The Great Age Controversy

In the 1990s, astronomers armed with the Hubble Space Telescope were able to make a quantum leap forward in studying globular clusters by gazing into their hearts, searching for the black holes that are thought to exist at their centers, and tracing the motions of faint subdwarf stars. For the first time, they could resolve individual stars of globular clusters in the Andromeda Galaxy, 2.5 million light-years away, and gauge the distances between galaxies with unprecedented accuracy. In light of all these new advances, the notion that globular clusters appear to be older than the universe that contains them seems doubly ridiculous.

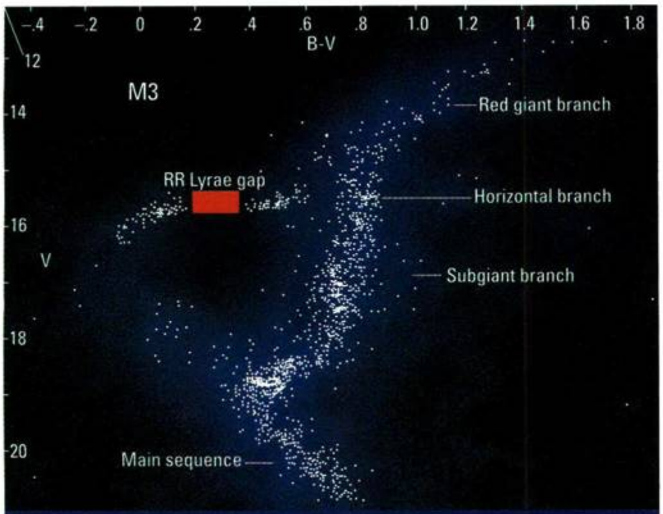
Yet this controversy hasn't completely died out. Many astronomers make their livelihoods by creating distance estimates for galaxies, most often those in the Virgo Cluster, the nearest large galaxy cluster to our Local Group. These distances help pin down a value for the Hubble constant, which is related to the speed of the universe's expansion, and hence its age. In the past decade, different experiments produced values for the Hubble constant of anywhere from 40 to 100 kilometers per second per megaparsec. But improvements in astronomers' understanding of how to find distances and the superior capabilities of Hubble are bringing the values closer together. Most astronomers now believe the Hubble constant is somewhere in the neighborhood of 65 to 75 km/s/Mpc, which might produce a younger universe than the 15 billion years once dreamed about. A few estimates of the universe's age have shrunk to as little as 8 billion or 9 billion years.

Yet William E. Harris of McMaster University in Hamilton, Ontario, maintains that the oldest globular clusters "stubbornly resist being younger than 11 billion years." He is a prominent authority on globular clusters and upholds the consensus that for globular clusters to exist, the universe must be older than 8 billion or 9 billion years.

Most astronomers are convinced that globular clusters are old because the life cycle of their stars is so long. Stars usually spend billions of years converting hydrogen atoms into helium, lying on a line called the main sequence that stretches diagonally across the HR diagram. Although the reactions in a star's interior are forever hidden from view, astronomers can make conclusions about them by observing how brightly and with what colors a star shines. As the hydrogen in the core gets used up, conditions begin to change; the star leaves the main sequence to become a red giant. Astronomers can see this happening with M3. The stars near the bottom of the diagram are still on the main sequence, but the others have left it (see illustration below).

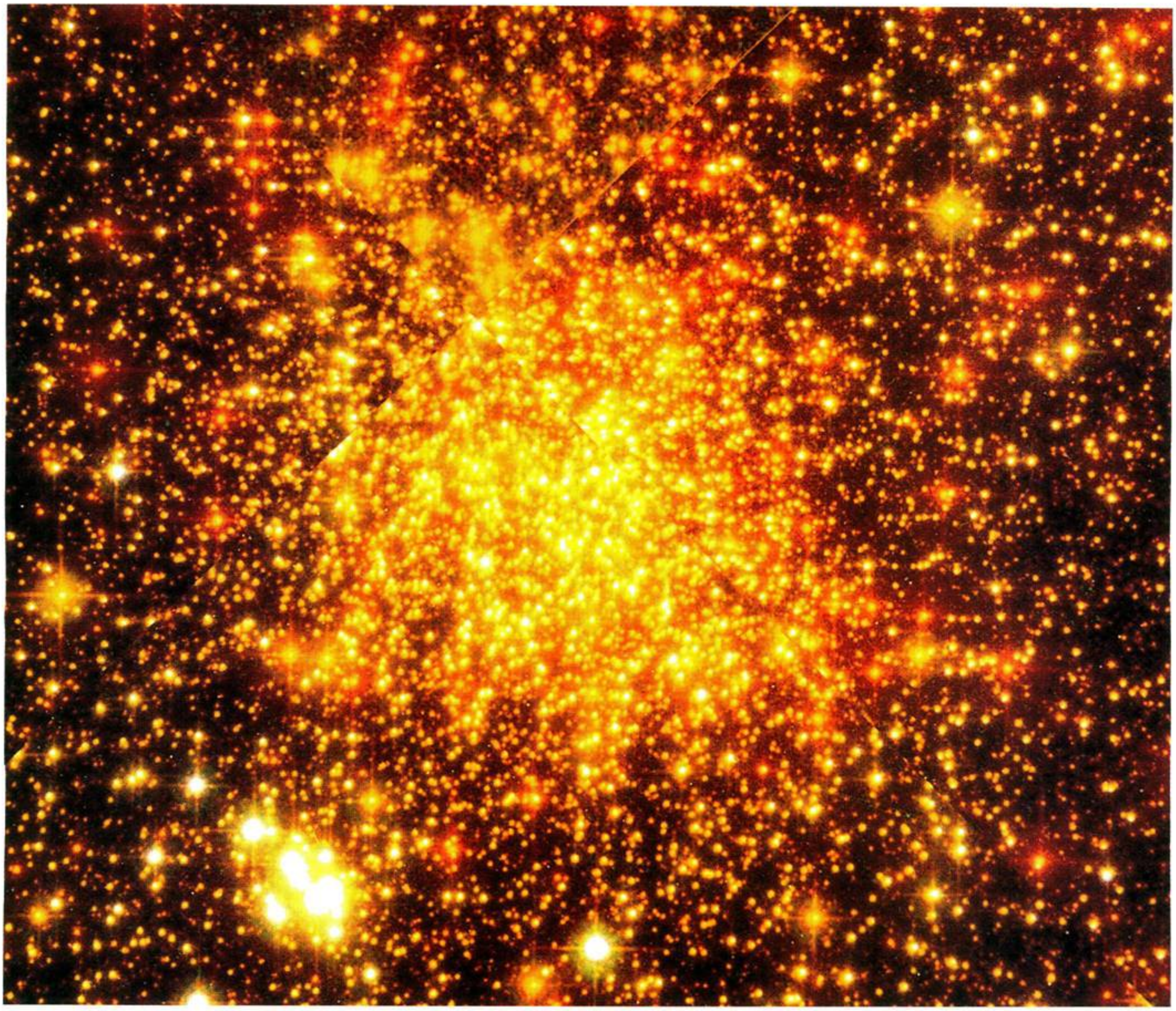
Astronomers have written computer programs to determine how the color and brightness of a star changes during its lifetime. By connecting points between stars of the same age, they get what is called an isochrone. Once someone has found the distance to a particular globular cluster, astronomers can match its lower main sequence with that of the best-fitting isochrone. This gives them the cluster's approximate age. Even if the fit is good, the age estimate will be uncertain by 25 percent. Yet astronomers insist that despite these uncertainties, we understand the reactions inside stars well enough to know that the oldest globular clusters needed at least 11 billion years to become the objects we see today.

But if the universe is at least 11 billion years old, the Hubble constant should be closer to 52 km/s/Mpc. Therein lies the problem. The stellar models are hard to argue with, but it's just as difficult to say that dozens of distance-scale experiments are wrong, especially when the distances astronomers get from independent methods agree with one another.



An HR diagram of M3 plots brightness against color and reveals the cluster's sunlike stars at bottom, giants winding upward, and regular variables called RR Lyrae stars at left.

Although it is 2.5 million light-years away, cluster G1 in the Andromeda Galaxy is resolved into stars by the Hubble Space Telescope. STScI



Some apparently old clusters of stars, such as NGC 1850 in the Large Magellanic Cloud, are actually unusual open clusters. STScI

Many fingers are now pointing toward cosmology as the culprit. Our understanding of the early universe and its topology is increasing dramatically, but so far it is the weak link in the chain. It's quite possible that the Hubble constant is not related to the age of the universe in the way we think it is. Further work in this area will eventually resolve the paradox.

Probing the Galactic Life Cycle

Globular clusters are the first objects that coalesce when a galaxy forms. During their lives, they exist pretty much independently, which means they carry with them information about a younger universe. Studying globular clusters is a step toward understanding the processes that build galaxies from amorphous clouds of gas.

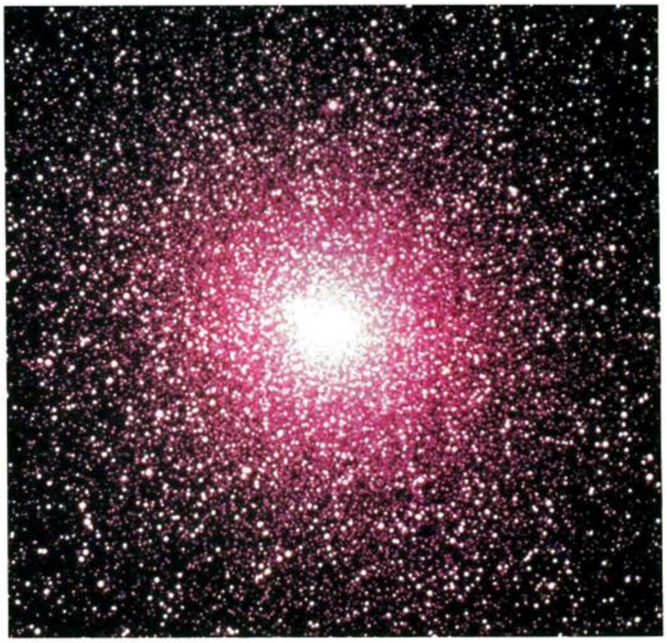
Naturally, the closest globulars show the most detail. But we have an incomplete picture of the Milky Way's globular cluster system because of obscuring gas and dust. To get a more complete idea of how spiral and elliptical galaxies came to be, we must look further afield. Fortunately, the increasing capabilities of large ground-based telescopes and the incomparable views from Hubble are allowing us to study the globular cluster systems of galaxies far outside the Local Group.

One of the simplest ways to study a globular cluster system of a single galaxy is to count the number of clusters and sort them according to brightness. This produces what's called a globular cluster luminosity function, and its shape can be approximated by a bell curve. Intriguingly, the shape is reproduced in all galaxies studied to date. Despite enormous variations in the size, brightness, structure, and location of the host galaxy, the bell-curve shape is always there.

More importantly, the central peak, or "turnover," shows nearly the same brightness from one galaxy to another. This is a good indication that globular clusters form in the same way no matter where they are in the universe and that all galaxies, whether spiral or elliptical, undergo the same processes early in their lifetimes. Detecting the underlying similarities of this kind is the first step toward developing a comprehensive theory of galaxy formation.

We can also use the turnover as a "standard candle" — an object or phenomenon of known brightness to gauge the distances between galaxies. So far, astronomers have used it

The heart of globular M15 in Pegasus reveals a dense region of stars that could indicate the presence of a central black hole. STScI



Omega Centauri, one of the Milky Way's globular cluster heavyweights, holds more than a million stars in its gravitational lock. ESO

with good results on galaxies in the Virgo Cluster, which are known to be about 50 million light-years away. However, it will be a few years before this technique can be used on the more remote galaxy clusters such as Hydra, Coma Berenices, and Perseus. These galaxies are so far away that even the largest ground-based telescopes can't see their luminosity function turnovers.

But as with so many things, the luminosity function raises more questions than it answers. For example, vastly more faint stars than bright ones exist in the universe. But the number of globular clusters in a galaxy decreases as you move past the turnover. Why does this happen? Is there a process that disrupts small, faint globular clusters, or do they never form at all? More importantly, why does the turnover occupy that precise location and why is it so consistent?

All these questions are linked to how globular clusters are born, a process about which embarrassingly little is understood. Although astronomers are refining their ideas of galaxy formation, the picture of how globular clusters form is still only a charcoal sketch.

Specific Frequency

Another compelling mystery relates to the formation question: Why do some galaxies have a lion's share of globular clusters, while others have few? The overall number of globular clusters in a galaxy depends on three things: the type of galaxy, where it is located, and how bright it is. To compare galaxies, William Harris and Sidney van den Bergh of the Dominion Astrophysical Observatory in Canada have come up with a value they call the specific frequency. This is the number of globular clusters in a galaxy divided by the galaxy's total brightness. It gives a hint of the number of globular clusters relative to the other stars. Figuring out the specific frequency for a galaxy lets astronomers know how efficient it was at creating globular clusters out of the available gas.

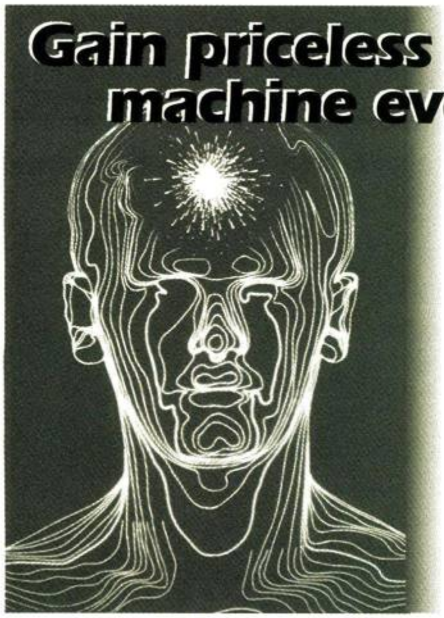
Some types of galaxies are usually better at creating globular clusters than others. Spiral galaxies that aren't part of a galaxy cluster ("field spirals") are usually the laziest, with specific frequencies of 1 or 2. Next come cluster spirals, field ellipticals, cluster ellipticals, and then giant ellipticals. Generally, the denser the environment, the more globulars a galaxy is likely to produce.

Lately, a push has been made toward studying cD galaxies — supergiant ellipticals with extended halos, which lurk near the centers of rich galaxy clusters. Each cD galaxy has thousands of globulars; in fact M87 (NGC 4486) has more than 100 times as many as the Milky Way. But if we compare the specific frequencies of cD galaxies, we can see that some have two or three times fewer globulars per unit of starlight. Astronomers know of no compelling reason why some cDs are highly efficient at making globular clusters while others are no better at it than garden-variety ellipticals.

Because of their giant halos and the fact that there is only one cD in any galaxy cluster, cDs are thought to have a different history than smaller galaxies. Thus far, the prevailing theories for how cD galaxies get their halos have included theft (cD galaxies steal the matter from other galaxies as they pass one another), cannibalism (cD galaxies are built up out of the smaller ones they've swallowed), and encounters in the dark (cD galaxies are formed out of gas clouds before any stars are formed). The last idea seems best at explaining what astronomers see.

Whether we're using globular clusters to look into the history of the universe or merely to probe our little corner of it, there's no doubt about their amazing utility. Consider that the next time you have a nearby globular in your sights. Thinking about the incredible amount we have learned — and still stand to learn — from globular clusters may be as exhilarating as the clusters themselves are beautiful. ▣

Denise Kaisler studied astronomy at McMaster University in Canada before teaching English at Konyang University in Korea. This is her first article for Astronomy.



Gain priceless insight into the most amazing machine ever created—your own body!

Let the Teaching Company's 32-lecture video course **UNDERSTANDING THE HUMAN BODY** show you the wonders of anatomy and physiology.

The remarkable structure and functioning of the human body . . . explained in memorable, easy-to-use video lectures

PART I *(Lectures 1–8)*
Cardiovascular System: Anatomy & Physiology of the Heart & Great Vessels . . . Respiratory System: Anatomy & Physiology of the Lungs . . . Nervous System: Anatomy & Physiology of the Brain

PART II *(Lectures 9–16)*
Nervous System: Spinal Cord & Spinal Nerves . . . Autonomic Nervous System & Cranial Nerves . . . The Eyes . . . The Ears, Hearing & Equilibrium . . . Pathology & Trauma . . . Digestive System: Anatomy & Physiology of the Mouth, Esophagus & Stomach . . . Anatomy of the Pancreas, Liver & Biliary Tree

PART III *(Lectures 17–24)*
Digestive System: Physiology of the Pancreas, Liver & the Biliary Tree . . . Anatomy & Physiology of the Small Intestine, Colon & Rectum . . . Endocrine System: The Pituitary & Adrenal Glands . . . Pancreas . . . Thyroid & Parathyroid Glands . . . Urinary System: Anatomy & Physiology of the Kidneys, Urethras & Bladder

PART IV *(Lectures 25–32)*
Reproductive System: Male & Female . . . Physiology of Genetic Inheritance . . . Musculoskeletal System: Physiology, Physics & Anatomy of the Muscles & Bones . . . The Immune System . . . What Can Go Wrong?

LIFETIME SATISFACTION GUARANTEED

ABOUT YOUR PROFESSOR...

DR. ANTHONY GOODMAN (A.B., Harvard; M.D., Cornell) teaches microbiology and gross anatomy in the Medical Sciences Program of Montana State University. For 20 years a general surgeon specializing in the treatment of cancer, he has served as an examiner for the American Board of Surgery and is a Fellow of the American College of Surgeons and a Diplomate of the American Board of Surgery. He has published numerous papers on both clinical and experimental surgery.

To order, use the coupon or call
1-800-TEACH-12
(1-800-832-2412)
please refer to Priority Code 10381
or FAX: 703-912-7756

In this 32-lecture video course, Dr. Anthony Goodman puts a solid understanding of human anatomy and physiology easily within your grasp.

You'll learn to see the structure and functioning of our bodies as an awesome, integrated unity, a perspective that reveals the logic and symmetry of the human organism with compelling clarity.

Order by November 10, 2000 and pay just $149.95 for *UNDERSTANDING THE HUMAN BODY: AN INTRODUCTION TO ANATOMY & PHYSIOLOGY* on video.

That's almost 2/3 off the usual price, and shipping is free. Call toll-free 1-800-TEACH 12 (1-800-832-2412) today, or shop securely on-line at www.teachco.com.

Vital knowledge of your own body and its workings should be no secret. The Teaching Company has made that knowledge easier to gain than ever. This extraordinary course will familiarize you with every one of the body's wondrous systems —cardiovascular, respiratory, nervous, musculoskeletal, digestive, reproductive, and endocrinal.

"It is excellent, outstanding and informative." —Beatrice Antholz, Milford, DE

Learn how structure and function go together to make us what we are

Dr. Goodman combines the study of anatomy and physiology in a meaningful, exciting manner that is simple to grasp. By putting the structure of our bodies in the context of their function, he relates anatomy to those normal processes that keep us alive.

Each lecture concentrates on an organ or organ system, such as the heart and blood vessels. First, you'll examine the gross anatomy, the structure that can be seen by the unaided eye. You'll also learn the microscopic anatomy of structures too small to be seen without the help of a microscope. Following that, Dr. Goodman explains the physiology, or functioning, of that organ system, concluding with some discussion of disease and ways it can be prevented and treated.

SAVE up to $250!
Off good until November 10, 2000.

NOTE: These lectures on human anatomy and physiology are intended to increase the understanding of the structure and function of the human body. They are in no way designed to be used as medical references for the diagnosis or treatment of medical illnesses or trauma.

Neither The Teaching Company nor Dr. Goodman can be responsible for any result derived from the use of this material. Questions of diagnosis or treatment of medical conditions should be brought to qualified medical personnel.

Now you can order Teaching Company courses securely on-line at www.teachco.com

The Teaching Company®
7405 Alban Station Court, Suite A107
Springfield, VA 22150-2318

THE
Great Courses
on Tape®
from the Science series...

Priority Code 10381 **FREE SHIPPING!**

Please send me **Understanding the Human Body: An Introduction to Anatomy & Physiology.**, which consists of six parts of thirty-two 45-minute lectures each, on audio- or videocassette in handsome storage cases.

☐ Video: **SALE**—$149.95 + ~~$20 S&H~~
(reg. price $399.95)

Note: Virginia residents please add 4.5% sales tax.

☐ Check or Money Order enclosed

☐ VISA ☐ MasterCard ☐ ☐

ACCOUNT NUMBER

SIGNATURE EXP. DATE

NAME (PLEASE PRINT)

MAILING ADDRESS

CITY/STATE/ZIP

PHONE *(If we have questions regarding your order)*

☐ **Please send me a free copy of your current catalog (no purchase necessary)**

Embracing THE END

Enter an era when the remnants of stars collide, scatter into space, and finally decay into nothingness.

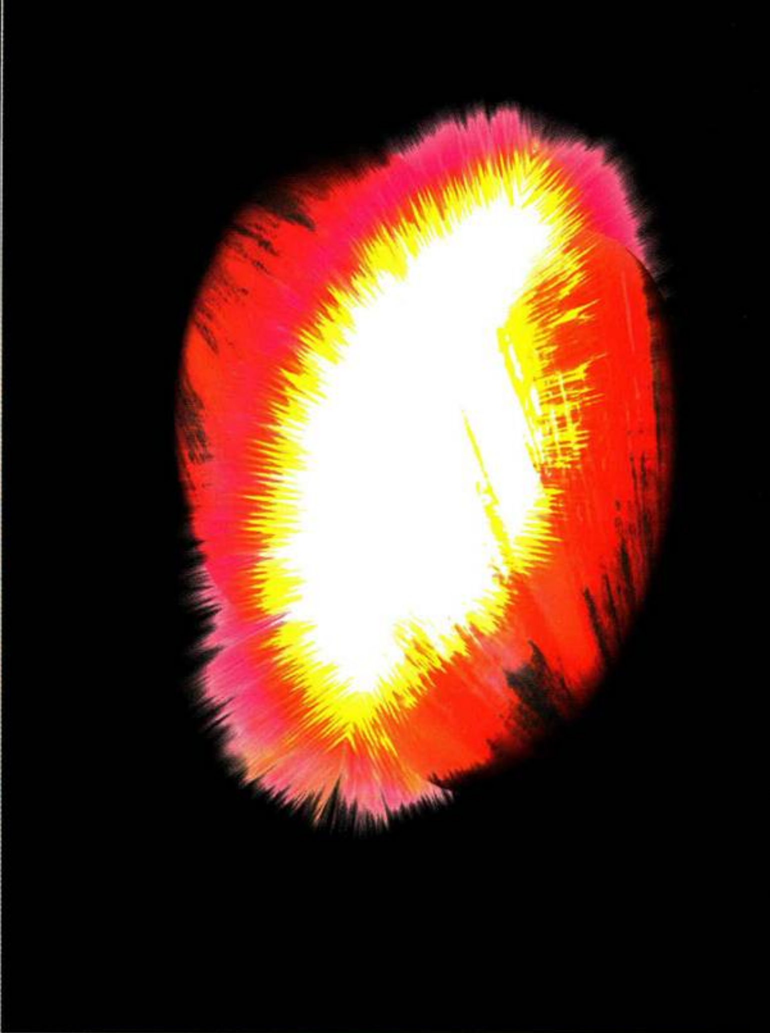
by Fred C. Adams and Greg Laughlin
illustrations by Elisabeth Rowan

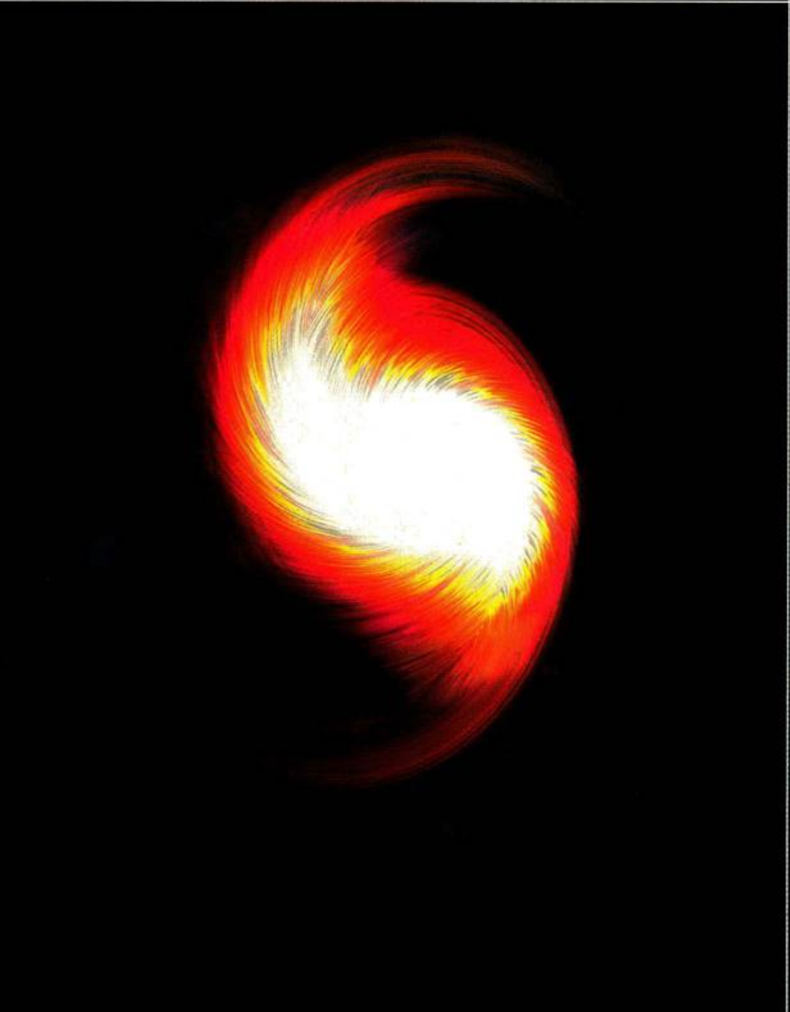
What happens when the stars have stopped shining? In 100 trillion years, the last generations of stars will have been wrung from depleted interstellar clouds, and the evolution of the few remaining red dwarfs will be slowly drifting to a finish. As the dynamic cycle of stellar births and deaths fades into a memory, the universe shifts its temperament, restocks its inventory, and continues its evolution.

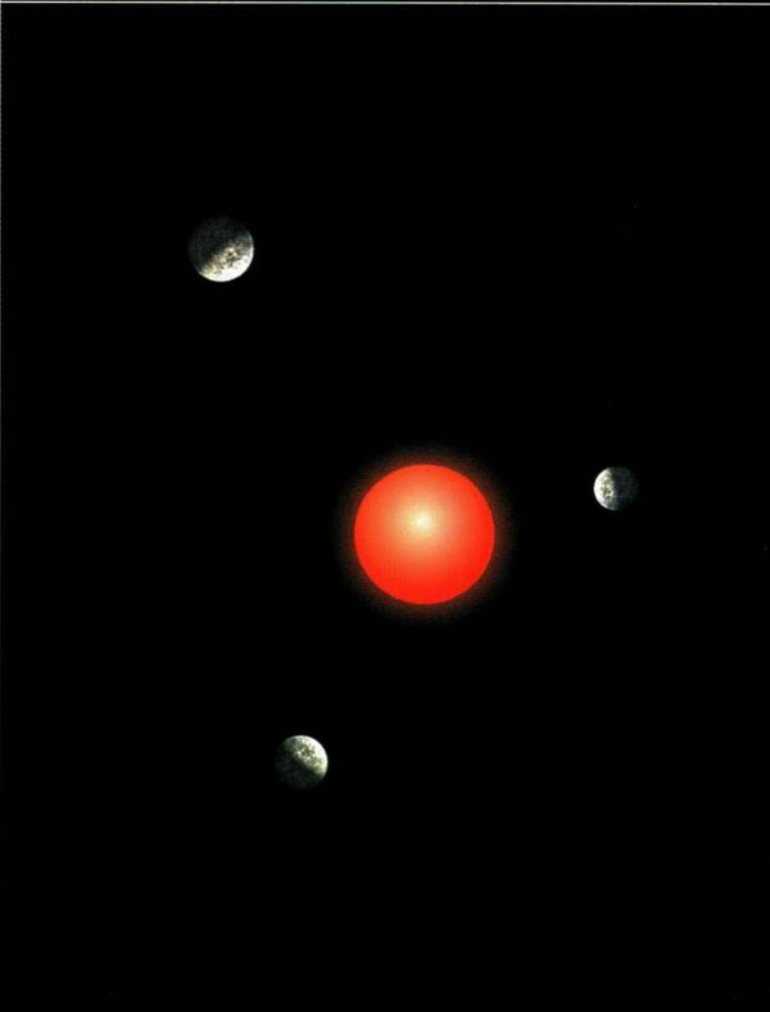
As the universe enters what we call the *Degenerate Era*, some thousand trillion years from now, the effects of change are quite evident. Conventional hydrogen-burning stars have given way to a stockpile of degenerate stellar remnants — brown dwarfs, white dwarfs, neutron stars, and black holes — that provides the astronomical grist of this era (see "Cast of Characters," page 52). Although at this advanced time these objects may seem cold and desolate, they will be the source of action and excitement in the universe. The clock pacing the rate of unfolding events runs much more slowly. Astrophysical events that could never happen in the current universe, because of severe time limitations, begin to occur.

Two brown dwarfs spiral inward until they collide and merge. The merger forms a low-mass star and perhaps planets (lower right). The new star is one of the universe's few beacons of light in the cold, desolate Degenerate Era of the far distant future.

From THE FIVE AGES OF THE UNIVERSE by Fred C. Adams & Greg Laughlin. Copyright © 1999 by Fred C. Adams and Greg Laughlin.
Published by arrangement with The Free Press, an imprint of Simon & Schuster, Inc.







THE FATE OF GALAXIES

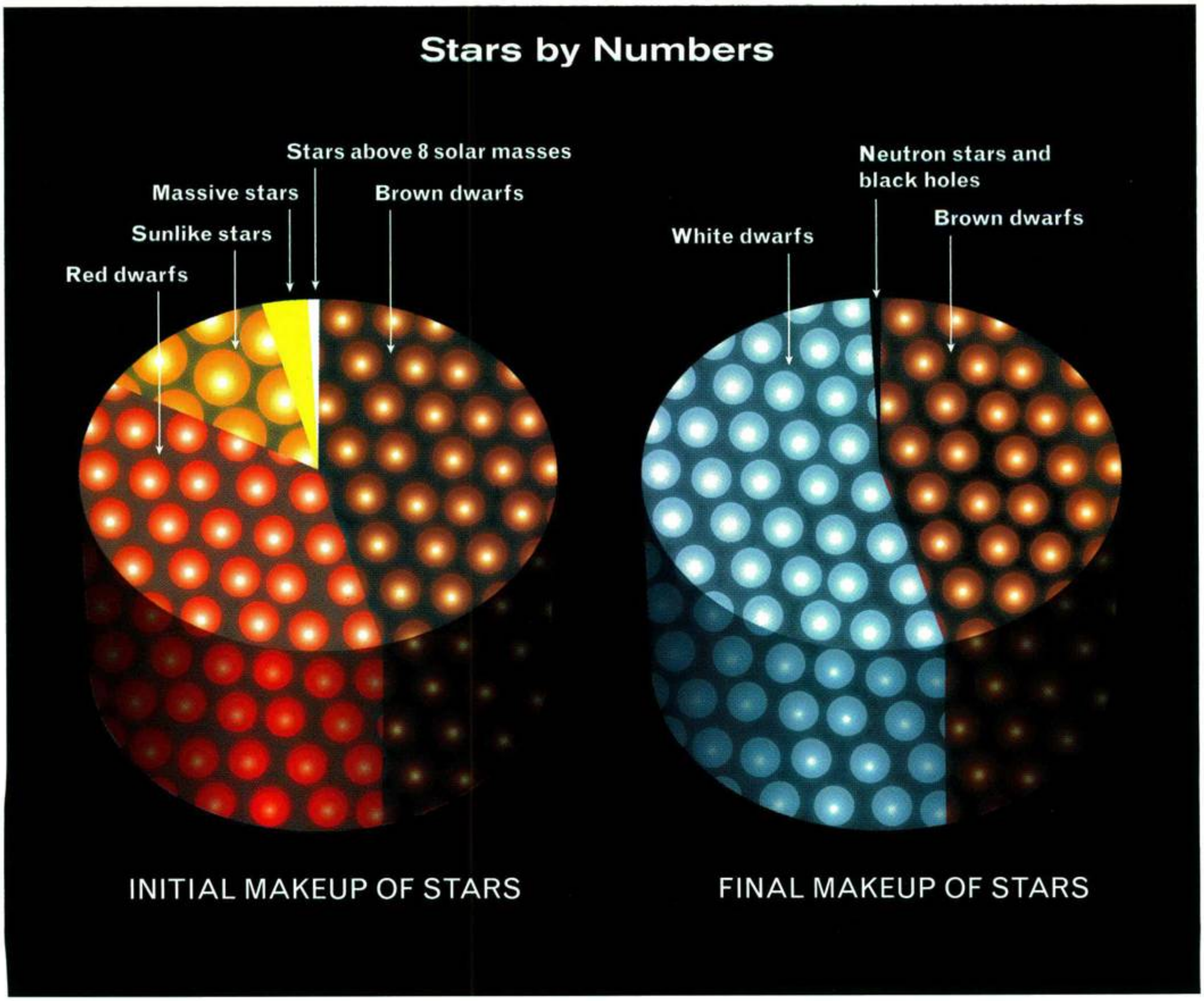
Our galaxy, the Milky Way, now contains 100 billion shining stars, which are collectively visible as a faintly glowing band that spans the night sky. In the Degenerate Era, the sky will appear pitch black. But the largest galaxies, held together by the gravity of cold dead stars and dark matter, will remain intact.

The gulfs between the stars in a galaxy like the Milky Way are so large that few, if any, direct collisions between stars have ever taken place. So far. Yet rare events can occur if given enough time. As the Degenerate Era gets underway, collisions and near collisions between stars become increasingly important. These encounters will completely rearrange the structure of the galaxy and ultimately lead to its demise. Because this epoch of destruction will not arrive until well into the Degenerate Era, however, the stars will be stellar remnants and the galaxy will have long since been folded into the sprawling product of successive galactic mergers.

Even at this time, direct head-on collisions between stars are relatively rare. Close encounters and near misses are much more frequent than true collisions. As the Degenerate Era unfolds, stars pass near each other on a regular basis, and interact through their joint gravitational attraction. The close passage of two stars leads to a small adjustment in the speed and direction of each star. The stars tend to scatter off of one another whenever they draw near.

Over the course of time, many scatterings take place, and their effects slowly accumulate. The net result is to redistribute the individual speeds of the stars orbiting within the galaxy. The smaller and lighter stars tend to pick up speed and gain orbital energy, whereas the heavier stars tend to lose their orbital energy. When a large number of stars participate in this redistribution of wealth, the galactic structure slowly changes in a process called dynamical relaxation. As this relaxation proceeds, some stellar remnants are given so much energy that they must leave the galaxy. As time goes on, more and more stars evaporate from the dying galaxy and are sent hurtling into intergalactic space at speeds of 675,000 miles (1.1 million kilometers) per hour.

As dynamical relaxation runs its course, the number of exiled stars increases and major structural changes are forced upon the galaxy. Because the stars that leave have the highest energies, the stars left behind have less energy on average. Energy is thus drained away. In response to the mounting energy crisis, the galaxy is compelled to grow smaller and denser. This galactic downsizing instigates even more stellar encounters and the banishment of more stars. As this process accelerates, a runaway situation can develop as the galaxy



ejects the majority of its stars and leaves behind a small minority in a tightly bound clump.

An unpleasant prospect awaits the low-energy stars that sink to the galactic center, where nearly all large galaxies are thought to harbor a supermassive black hole. These enormous black holes contain millions to billions of solar masses. As a galaxy relaxes, the central black hole absorbs wandering stars that stray too close. Throughout the Degenerate Era, these supermassive black holes will slowly gain weight on their steady diet of windfall stars.

Galaxies will persist for billions of times longer than the present age of the universe. Their remarkable durability is made possible by the huge separations between individual stars and the slow rate at which stars cross those distances. But given enough time, even galaxies must face their demise. During the next 10 million trillion to 100 million trillion years, most of the dead stars in a galaxy will escape through the process of stellar evaporation. A small fraction of the stars, perhaps 1 percent, will be consumed by the central black hole. After this process of dynamical relaxation has run its course, the life of a galaxy effectively comes to an end.

As the galaxy relaxes and disperses, the close encounters of passing stars have a devastating impact on any planets still circling the stars. These stellar scattering events tend to dislodge planets from their orbits and send them careening into the void. Planets with orbital radii comparable to that of Earth are scattered out of their solar systems after a thousand trillion years. Outer planets with larger orbits are more susceptible, and hence are long gone by this time. Even the innermost planets will be removed from their orbits during the Degenerate Era. By the time stars leave the galaxy, they will have long since been stripped of their solar systems.

WHEN DEAD STARS COLLIDE

The rare direct collisions between dead stellar remnants provide moments of extraordinary excitement, exclamation marks punctuating the almost endlessly desolate stretches of the Degenerate Era. These collisions can produce ordinary new stars, strange new types of stars, and spectacular explosions.

During this future epoch, most of the ordinary matter in the galaxy resides within white dwarfs. Although less mass is stored in brown dwarfs, which have smaller masses, roughly equal numbers are present. Within a large galaxy such as the Milky Way, the population of both white dwarfs and brown dwarfs should number in the billions. As the dead stars trace through their orbits, direct collisions sporadically take place, with about one event every few hundred billion years. Given the current age of the galaxy, about 10 billion years, the chances are roughly 9 out of 10 that no stellar collisions have occurred so far. As the universe grows older than several hundred billion years, collisions will begin to add up. Hundreds to thousands of stellar collisions will rock the galaxy by the time a million billion years pass.

The collisions between two brown dwarfs are of immediate astronomical, geological, and perhaps even biological interest. A large portion of the remaining hydrogen in the universe is locked up in brown dwarfs, which do not burn their hydrogen into heavier elements. When two brown dwarfs collide at a sufficiently direct angle, they can form a composite stellar object containing most of the original mass of the two stars. If its combined mass is above the threshold for stardom, the interaction product can contract and heat up until sustained hydrogen fusion lights up the newly formed stellar core. The star will turn on. The small red stars that emerge from these freak collisions will subsequently live for trillions of years.

Through these astronomical crashes, new stars can be made long after the interstellar medium has run out of gas. In a galaxy the size of the Milky Way, about a hundred of these stars will be shining at any given time. The combined starlight of these dim red stragglers endows the galaxy with a total power output comparable to that of the present-day sun.

Brown dwarf collisions can also create new planets. Unless the collision is precisely head-on, some of the gas from the brown dwarfs will be swirling too rapidly to be incorporated into the newly forged star. This spinning material readily forms a disk of gas and dust around the young stellar object. Because the formation of planets is a likely outcome of an evolving disk, these new stars are thus inclined to give birth to new planetary systems.

Collisions between white dwarfs can lead to even brighter, albeit shorter-lived, fireworks. If two white dwarfs collide and merge and their combined mass is above about 1.4 solar masses, the pressure exerted by electrons cannot support the merger product against gravitational collapse. The newly formed but overweight star must then explode as a supernova. About one out of ten collisions between white dwarfs will detonate a supernova. As a result, the galaxy is slated to experience about one explosion every trillion years as long as it remains intact, for about 100 million trillion years. Supernovae are impressive today, but they will be truly spectacular in the impoverished environment of a dying galaxy during the Degenerate Era.

The more likely outcome of a rare collision between two white dwarfs is the formation of an odd new type of star. Most white dwarfs descend from low-mass stars and are composed of almost pure helium. If the final collision product has a mass greater than 0.3 solar mass and the collision imparts enough heat energy into the star, the object can ignite helium in its interior. Such a star would be hotter, brighter, and denser than the sun, but live for only a few hundred million years. If the collision product ends up with more than 0.9 (but less than 1.4) solar mass, carbon fusion could start in its core. Even hotter, brighter, and denser than a helium-burning star, these exotic objects would survive for only a million years.

THE END OF DARK MATTER

Galactic halos are composed largely of dark matter, which emits little or no light and may not even be made out of the protons and neutrons that form ordinary matter. One of the leading candidates for this dark matter has been named weakly interacting massive particles. These rather strange particles, weighing in at 10 to 100 times the mass of the proton, interact only through the weak nuclear force and gravity.

The annihilation of dark matter takes place in two different settings. In the first case, when two particles meet in the galactic halo, they can interact and directly annihilate each other. In the second case, the particles are captured by stellar remnants, such as white dwarfs, and then subsequently annihilate with each other inside the stellar cores.

The dark matter of the galactic halo provides a background sea of particles that are continually streaming through space. These particles also stream through all the objects in the galaxy, including stars, planets, and, at the present cosmological time, people. Approximately 100 billion such particles are passing through you every second. Because these particles interact through the weak force, and because the weak force is *very* weak, they pass right through all types of matter with essentially no effect. Every once in a while, however, a dark matter particle does interact with the nucleus of an atom and thereby relinquishes some of its energy.

If an interaction occurs within a white dwarf, the dark matter particle can remain gravitationally bound to the star. Over vast expanses of time, the population of these dark matter particles gradually builds up inside the object. The time required for dark matter to be captured through this process is much longer than the nuclear burning lifetimes of the stars, which live as stellar remnants for nearly all this time. As the concentration of dark matter particles increases in the stellar core, the opportunities for particles to annihilate increase. In the long run, the star reaches a steady state in which annihilation occurs within the stellar remnant at the same rate that particles are captured from the galactic halo.

The process of dark matter capture and annihilation provides a vitally important energy source for the white dwarfs of the future. These stellar remnants are left over from stellar death, after nuclear reactions have shut down. In the absence of an additional energy source, white dwarfs would become colder and dimmer until they reach the background temperature of the universe. Because of the energy they usurp from dark matter annihilation, however, white dwarfs can radiate energy for a very long time. The total power produced by a single white dwarf through this annihilation process is about one quadrillion watts. Although this feeble power output is about 100 billion times smaller than that of the sun, this energy production mechanism will run the universe in the future. Such energy generation can continue as long as the galactic halo remains intact, roughly 100 million trillion years, or 10 billion times longer than the hydrogen burning lifetime of the sun.

The dark matter particles captured by white dwarfs ultimately annihilate into radiation, which eventually dominates the background radiation field of the universe. Before leaving the star, however, this radiation is degraded to longer wavelengths and hence lower average energies. Photons leave the stellar surface with a characteristic wavelength of about 50 microns, 100 times longer in wavelength than the light emitted by the sun. This infrared radiation is invisible to human eyes but easily detected using present-day technology. The surface temperature of the star is a cool 63 kelvins (–346° F), just below the temperature of liquid nitrogen.

At this epoch in the future history of the universe, galaxies will appear quite different than they do today. A typical galaxy contains billions of stellar remnants, all radiating energy through the process of dark matter capture and annihilation. An entire galaxy of these stellar remnants has a total power output comparable to that of our sun. Scattered among these faintly glowing remnants are about 100 more traditional stars manufactured through brown dwarf collisions. Although rather dim by the standards of today, these small stars will be veritable beacons of light against the darkness of the future. The total power generated by these few bona fide stars will outshine the billions of white dwarfs.

Cast of Characters

In the Degenerate Era, the inventory of the entire universe consists of four principal types of stellar remnants, the objects left over after stellar evolution has run its course.

Brown dwarf — A stellar object that contains less than 0.08 the mass of the sun, too little to produce sustained nuclear fusion in its core. Because brown dwarfs don't fuse their hydrogen fuel, they are the principal repository of this basic element during the Degenerate Era.

White dwarf — A small, compact stellar remnant supported by the pressure of degenerate electrons. Stars that begin life with between 0.08 and 8 times the mass of the sun end their lives as white dwarfs. Their final size, however, must remain below 1.4 solar masses.

Neutron star — An even smaller and denser stellar remnant supported by the pressure of degenerate neutrons. Stars that begin life with more than 8 solar masses of material eventually exhaust all their fuel, triggering a core collapse and resulting supernova explosion. The compact core left behind is the neutron star, which has the diameter of a city.

Black hole — The ultimate stellar remnants, black holes form when the most massive stars reach the end of the line and even the pressure from degenerate neutrons fails to prevent their cores from further collapse. The resulting object creates a region of spacetime in which the gravitational field is so strong that even light cannot escape.

THE ULTIMATE FATE OF STARS

The final chapter of stellar evolution plays itself out as the very stuff of matter — the protons — decay. Particle physics predicts that the proton, long thought to be stable and infinitely long-lived, can decay into smaller particles if given enough time. Exactly how much time, however, is not known. Although the true proton lifetime has not been measured experimentally, we adopt a representative proton lifetime of 10 trillion trillion trillion years. When protons decay inside a star, a white dwarf for example, energy is added to the stellar budget. The net result is to convert the rest mass energy of the proton into gamma radiation, which heats up the star. Decaying protons thus endow the star with an internal energy source, but only at a high price: The star must surrender its own rest mass energy to create the heat and light.

A white dwarf powered by proton decay has a luminosity of about 400 watts, barely enough to run a few light bulbs. An entire galaxy of such stars has a luminosity 10 trillion times smaller than the sun. Even if we add together the power from all the stars in all the galaxies currently visible, the total would still be 100 times less than that of the sun. This future is dim indeed.

Inside the white dwarf, radiation must scatter many times before it can diffuse its way out to the stellar surface. During this future epoch, the surface temperature of a white dwarf will be a frigid 0.06 kelvins, about 100,000 times colder than the sun. As a result, these 400-watt light bulbs do not make

Life on a White Dwarf

Although familiar types of life may well find their survival in jeopardy, the Degenerate Era will not necessarily be devoid of life. Obviously, any discussion of future life-forms brings us into the realm of speculation. But it is certainly plausible to think life could evolve on a planet formed in a brown dwarf collision, or that existing life could survive by harnessing the total power output of a white dwarf. But perhaps the most intriguing possibility for future life exists in the atmospheres of old white dwarfs.

The first requirement for life is a proper mix of elements. White dwarfs of higher mass naturally contain large amounts of carbon and oxygen, two of the most important elements in terrestrial organisms. And for an extended span of time, a white dwarf has a surface temperature of approximately 63 kelvins (–346° F), close to that of liquid nitrogen. With a steady supply of energy from below and the right chemical mix, the outermost layer of a white dwarf has the capability, in principle, of sustaining chemical reactions.

Let's carry this gedankenexperiment (an experiment carried out by thought alone) even further by making some rough estimates for life-forms living in the atmospheres of white dwarfs. Following the lead of Institute for Advanced Study physicist Freeman Dyson, we assume that life obeys a scaling law, which in turn implies that the subjective time experienced by a living creature depends on its operating temperature. For lower temperatures, the effective pace of life is slower, and it takes longer for a creature to experience the same number of instants of consciousness.

For our speculative biota evolving near the surface of a white dwarf, the ambient temperature must be near 63 kelvins, about five times less than the temperature of a mammal. The scaling hypothesis says that such a creature requires five times as much real time to experience the same effective amount of time. On the other hand, a white dwarf powered by the annihilation of dark matter generates energy at a rate of one quadrillion watts, about 100 times less than the rate at which Earth intercepts solar energy.

So compared to life on Earth, life in white dwarf atmospheres loses a factor of five for having a slower metabolic rate and loses another factor of 100 for having less power. This loss of a factor of 500 is more than made up by the time available, which is 100 billion times longer. Combining these two competing effects, we estimate that life in a white dwarf atmosphere has a numerical advantage of about 100 million. Even if the evolution of life in a white dwarf atmosphere is 100 million times less efficient than biological evolution on Earth, the star still has enough time and energy to engender a web of life-forms comparable in scope to the biosphere on Earth today.

very good reading lamps. They emit radiation with a characteristic wavelength of 5 centimeters, about 50,000 times too long for human eyes to see.

As a white dwarf continues to lose mass through proton decay, its structure changes markedly. Because of the counterintuitive nature of degenerate matter, a white dwarf expands in radial size as it withers away. As the star expands, the density becomes lower, and the matter eventually ceases to be degenerate. The transition occurs when the stellar mass falls to that of Jupiter, about 1,000 times smaller than the mass of the sun. At this point in its evolution, the star has the density of water and a radius 10 times smaller than the sun. The star consists of a frozen array of hydrogen atoms — a rock-hard ball of hydrogen ice.

After degeneracy has lifted, the crystalline white dwarf continues to waste away until it is so small that it can no longer function as a star. This final transition marks the end of stellar evolution. True stellar death occurs as the object becomes transparent, when radiation propagating inside the star can escape freely. At this turning point, the star contains about 6,000 times less mass than Earth, or some 70 times less than the moon.

The penultimate fate of most stars is thus to end up as a puny hydrogen rock. The rock continues to evaporate away its mass as proton decay sputters toward completion. The ultimate fate of white dwarfs thus becomes clear: nothing is left. The entire mass energy of the star is eventually radiated into interstellar space, and thermodynamics triumphs over gravity in the long run.

The neutron stars, those rare and dense relatives of the white dwarfs, evaporate in a similar fashion. Proton decay empowers the neutron stars with approximately the same total luminosity, about 400 watts. But neutron stars, being the size of a city, are much smaller than the Earth-sized white dwarfs. In order to radiate the same total power, the stellar surfaces must be hotter, about 3 kelvins for a typical neutron star. This temperature is about the same as the present-day cosmic background radiation, which sets the lowest temperature available in the universe of today. In contrast, when the cosmos is 100 trillion trillion trillion years old, neutron stars softly glowing at 3 kelvins will be among the hottest objects in the universe.

By the time 10,000 trillion trillion trillion years have passed, nearly all of the protons in the universe have decayed and the degenerate stellar remnants have disappeared. The seemingly resolute and indestructible stellar remnants have given way to a diffuse sea of radiation. The universe takes on a whole new character. This vast arena of overwhelming desolation is punctuated by isolated regions of extreme spacetime curvature, in other words, black holes. As the Degenerate Era draws to a close, the black holes, containing from one up to billions of solar masses, push doggedly forward into the next epoch. A

Fred C. Adams is a physics professor at the University of Michigan in Ann Arbor. Greg Laughlin is a physicist at NASA's Ames Research Center in Moffett Field, California.

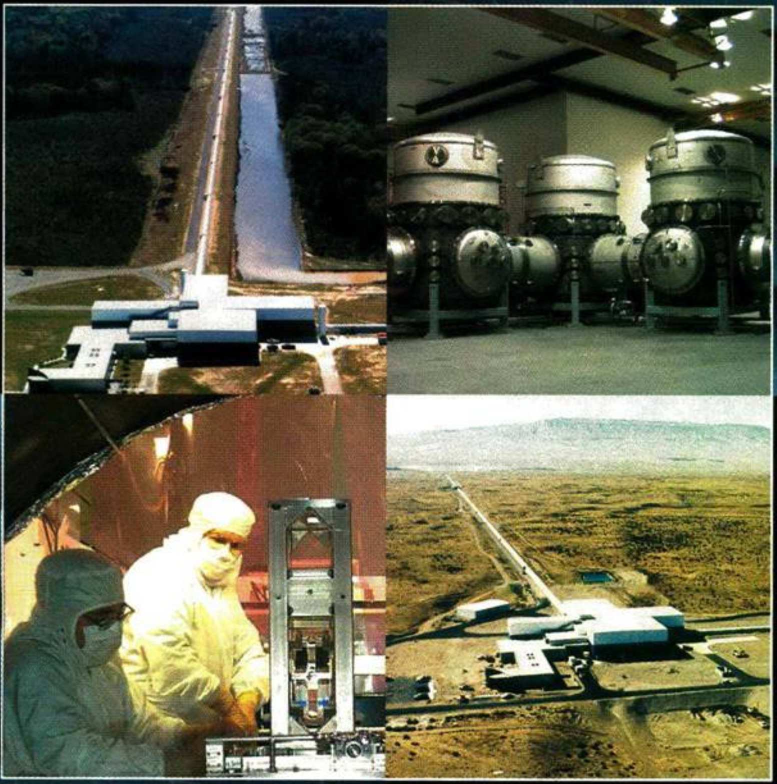
CATCH A GRAVITY WAVE

Two sprawling observatories in Washington and Louisiana will test one of Einstein's great theoretical predictions.

by Marcia Bartusiak

The Hanford Nuclear Reservation, currently the nation's prime repository for nuclear waste, sprawls over hundreds of square miles of scrub desert in south-central Washington state. The nearest town, Richland, is 10 miles away. At a key intersection, the road signs direct travelers to either continue west or turn south. There is no sign at all to explain the highway going north, the entrance to the reservation. It is a leftover habit from Hanford's many years as a national secret during World War II.

Five miles down that desolate road resides the Laser Interferometer Gravitational-Wave Observatory operated by the California Institute of Technology and the Massachusetts Institute of Technology. Those in the know simply call it LIGO (pronounced LIE-go). It is a rent-free guest on the Hanford site. Standing alone on the vast plain, a landscape long ago carved flat by the immense outflow of an ancient glacial lake, the complex resembles either a tasteful warehouse or a modern art museum inexplicably



Previous page, clockwise from upper left: The Louisiana LIGO seen from the air; vacuum chambers that hold LIGO's delicate optics; the Washington LIGO seen from the air; LIGO researchers in "bunny suits" setting up optics so the light beams will be properly aligned. Caltech/MIT/LIGO

placed in the middle of nowhere. An exact duplicate, painted in the same hues of cream, blue, and silver gray, can be found in the pine forests of Livingston Parish in Louisiana, outside Baton Rouge. Together, they form an astronomical tool of the 21st century, a detector like no other before it.

The signals these two observatories seek are waves of gravitational radiation, or more simply gravity waves, as they are better known in the popular media. Electromagnetic waves, be they visible light, infrared light, or radio waves, are produced by molecules, atoms, or electrons and generally reveal a celestial object's physical condition — how hot it is, how old it is, or what it is made of. Gravity waves will not convey such information. Instead, they will tell us about the motions of massive celestial objects. "It's both an exciting and overpowering change," says Gary Sanders, LIGO's deputy director. "There's almost a romantic attraction, this chance to look at a whole new window of the universe."

SPACEQUAKES

Gravity waves are literally quakes in spacetime that emanate from the most violent events the universe has to offer — a once blazing star burning out and going supernova, the dizzying spin of neutron stars, or the cagey dance of two black holes whirling around each other, approaching closer and closer until they merge. Gravity waves will tell scientists how large amounts of matter move, twirl, and collide throughout the universe. Eventually, this new method of examining the cosmos may even record the remnant rumble of the first nanosecond of creation, the remains of the ultimate spacetime jolt of the Big Bang itself.

Inside LIGO's main halls, at both Hanford and Livingston, the ambiance is almost reverential, akin to the response one might feel inside a darkened telescope dome. But this astronomical venture is vastly different. There are no windows to spy on the universe. Instead, two 4-foot-wide tubes at right angles to each other extend out into the countryside for 2.5 miles (4 kilometers). Together, these arms form a giant L in the landscape. The tubes resemble oil pipelines, although they can't be seen directly. Six-inch-thick concrete covers protect them from the wind and rain. In Louisiana, the concrete has also stopped occasional stray bullets during hunting season. A hit could be devastating because the pipes are as empty of air as the vacuum of space. Indeed, they surround the largest artificial vacuum in the world.

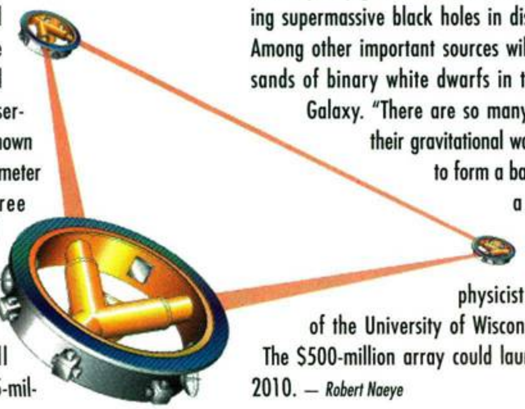
These gravity-wave observatories are firmly planted on cosmos firma, awaiting their first rumbles, vibrations predicted by Albert Einstein 84 years ago. "The worship of Einstein is the only reason we're here," says Rainer Weiss of MIT, one of LIGO's founding fathers. "If you go to Congress and tell them you're going to try to show that Heisenberg's uncertainty principle is not quite right, you run into blank stares. But if you say you're measuring something that's proving or disproving Einstein's theory, then all sorts of doors open. There's a mystique."

Einstein unleashed a revolution that altered the commonplace notions of space and time. His general theory of relativity showed that matter, space, and time are linked, producing the force known as gravity. Space and time are joined together into an entity known as spacetime, whose geometry is determined by the matter around it. According to general relativity, stars and other massive bodies dimple the spacetime around them, much the way a bowling ball creates a depression in an elastic mat. Planets and comets are attracted to the star because they follow the curved spacetime highway carved out by the stellar orb.

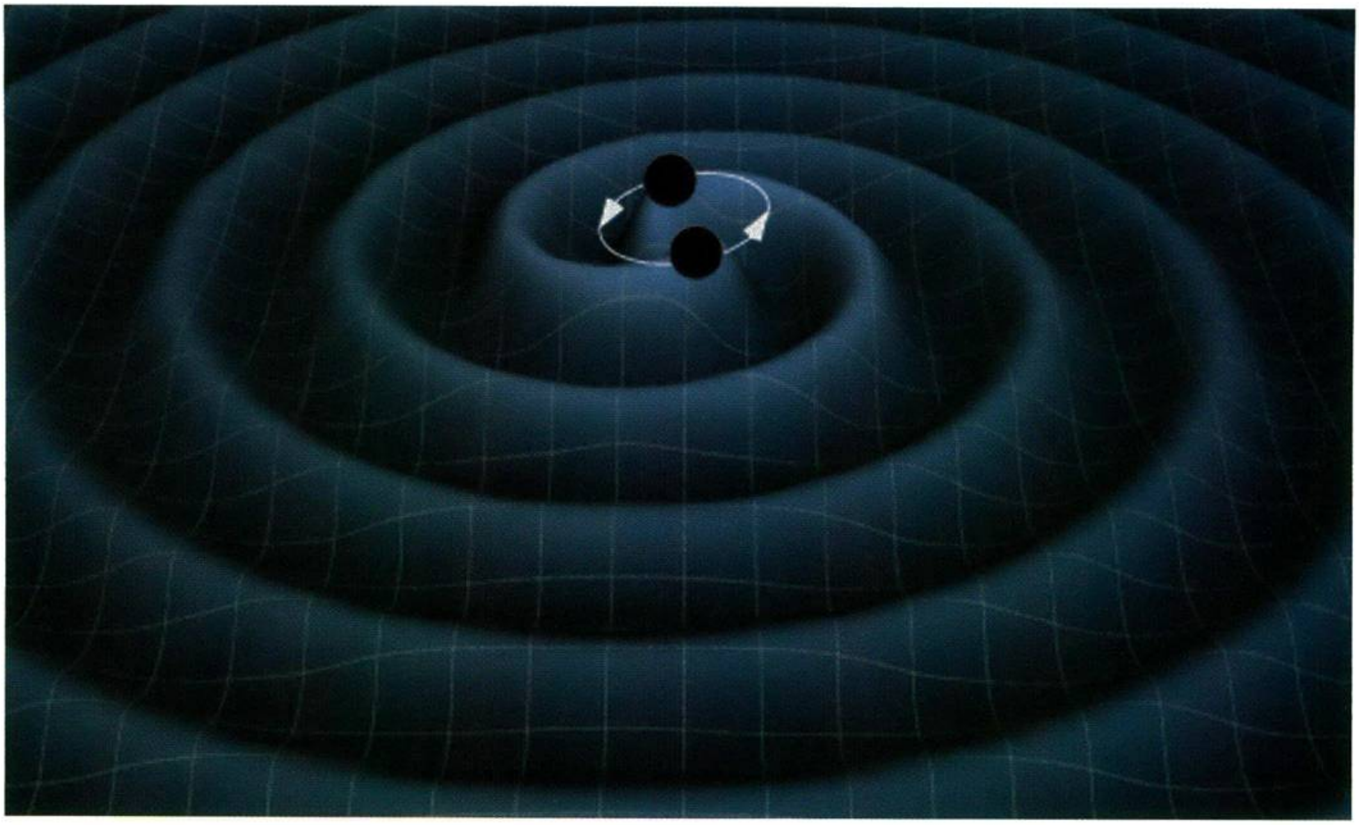
When it was first introduced in 1915, general relativity was hailed as a momentous conceptual achievement but thought to have little practical importance. How times have changed. Global Positioning Satellites, used regularly by hikers, sailors, pilots, and soldiers to keep track of their locations, continually require general relativistic corrections to keep in sync. Moreover, astronomers discovered intriguing celestial objects such as pulsars, quasars, and black holes that they could be understood only through the physics of general relativity. And yet the story of general relativity remains incomplete.

A major prediction of general relativity still awaits direct observational confirmation: gravitational waves. Einstein first mentioned them in 1916. He recognized that just as radio waves are generated when electrons travel up and down an antenna, gravity waves should be produced when masses move about. To understand this phenomenon, imagine one of the most violent events the universe has to offer — two supermassive black holes crashing into each other in the center of our galaxy. When this happens, space is shaken — and shaken hard. Such a colossal collision would send out a spacequake that surges through the cosmos at the speed of light. Its waves would not travel

LISA


William Folkner (JPL)/NASA

As scientists build LIGO and three other laser interferometers in Italy, Germany, and Japan, an international collaboration of American and European physicists are planning a space-based gravitational wave observatory affectionately known as LISA (Laser Interferometer Space Antenna). Three identical spacecraft will fly in an equilateral triangle formation far from Earth. Each spacecraft will fire a 3-million-mile (5-million-km) long laser beam toward one of its partners. This long reach will enable LISA to "hear"extremely low-frequency gravitational waves emitted by merging supermassive black holes in distant galaxies. Among other important sources will be the thousands of binary white dwarfs in the Milky Way Galaxy. "There are so many of these that their gravitational waves will merge to form a background noise at very low frequencies," says physicist Patrick Brady of the University of Wisconsin-Milwaukee. The $500-million array could launch as soon as 2010. — *Robert Naeye*



As two black holes spiral inward toward a fateful merger, they radiate gravity waves.

Tim Carnahan (GSFC)/William Folkner (JPL)/NASA

through space in the manner a light wave propagates. Rather, they would be an agitation of space itself. The waves would alternately compress and extend the fabric of spacetime.

Such waves would be deadly near the crash site. They would stretch a 6-foot man to 12 feet and within a millisecond squeeze him to three, before stretching him out once again. Any planets in the vicinity would be torn asunder. Fortunately, by the time such waves reached Earth, this cosmic tsunami would be reduced to a subatomic flutter. Were such gravity waves to hit this page, they would be so weak that they would squeeze and stretch the sheet's dimensions by a distance thousands of times smaller than the size of a proton.

Almost no one doubts that gravitational waves exist, for there is already powerful evidence they are real. Two neutron stars in our galaxy are rapidly orbiting each other, drawing closer and closer together. The rate of their orbital decay — about three feet per year — is just the change physicists expect if this binary pair is losing orbital energy in the form of gravitational waves. Joseph Taylor and Russell Hulse won the Nobel Prize in 1993 for this discovery. Direct reception of a wave, though, would offer the ultimate proof and provide astronomers with one of the most radical new tools to explore the heavens in four centuries. This explains the motivation to construct LIGO, as well as similar instruments of varying sizes in Italy, Germany, and Japan.

THE GONG SHOW

This entire endeavor began modestly in the 1960s as one man's quixotic quest. University of Maryland physicist Joseph Weber cleverly surmised that a burst of gravitational energy should set a large cylindrical bar of aluminum vibrating, much like a gong continuing to ring after being struck, though far more weakly. When he reported a detection in 1969, others around the world quickly constructed bar antennae. While most physicists remained highly skeptical of Weber's detections, he initiated a new branch of physics that has never diminished.

The seeds of LIGO, a scheme different from Weber's, can be traced to a classroom exercise three decades ago. To teach the concept of gravity waves during a general relativity course at MIT, Weiss asked his students to envision three mirrors suspended above the ground, their orientation forming the shape of an L. One mirror would be in the corner, the others at each end. Weiss understood that as a gravity wave travels it does two things: The wave compresses space in one direction — say, north/south — while simultaneously expanding it in the perpendicular direction — east/west. A gravity wave coming straight down on this L-shaped set-up would squeeze one of the arms so the mirrors would be closer together, while spreading the mirrors in the other arm farther apart. A millisecond later, as the gravity wave continues onward, this effect would reverse, with the compressed arm expanding and the expanding arm contracting. Weiss was rediscovering an idea that Weber and others had thought of earlier, but Weiss carried out a detailed study that envisioned nearly all the crucial pieces of the observatories now coming on line.

Weiss figured that a laser beam, bouncing back and forth between the mirrors at each end of the L, could track a gravity wave's expand/contract flutters. The light would enter the corner of the L. A beam splitter would split the light into two beams, each directed down an arm. After multiple reflections off the mirrors, the beams could be recombined, at which time they interfere with each other (hence the term "interferometry"). The beams could be initially set so that their waves arrive out of phase. In other words, when added together, the waves from both arms would cancel each other out. When the crest of the light wave in one beam is added to the trough of the light wave in the other beam, the result is darkness, like adding 1 and –1 to get zero. But if a gravity wave causes the arms to expand or contract, the two laser beams would travel slightly different distances. In that case, the recombined beams will be more in phase and would thus produce some light. The gravity wave would be spotted in those light changes.

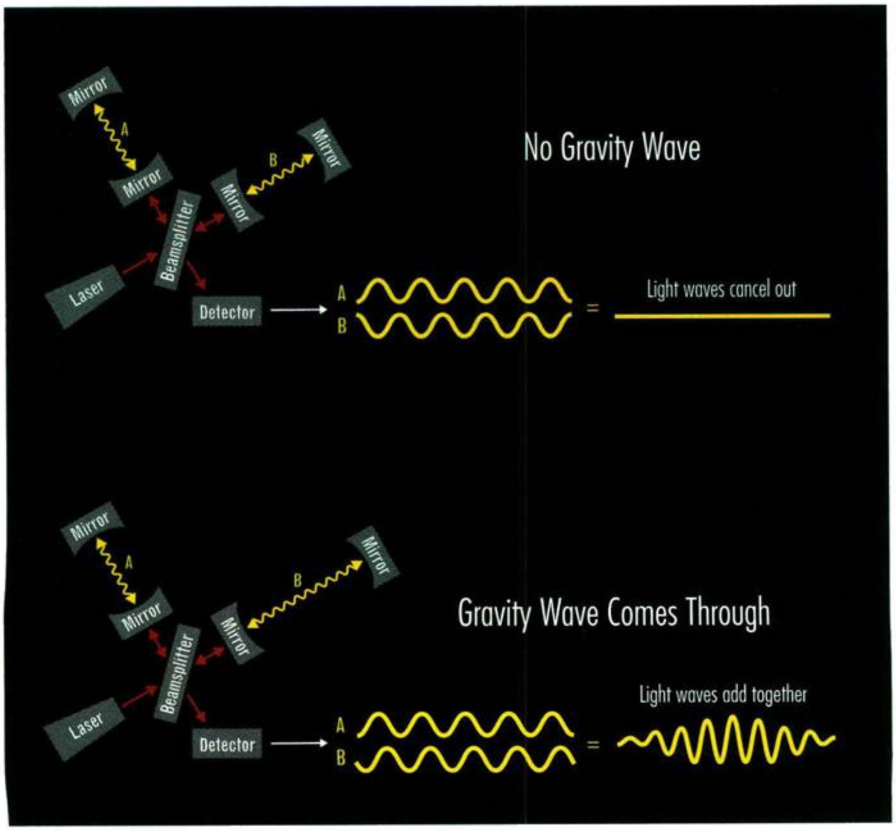
Weiss's concept caught on because it had a distinct advantage. A bar antenna can be tuned to only one gravity-wave frequency (as if it were a radio that could pick up only one station). A laser interferometer, on the other hand, is like a broad-band radio. It can detect a wide range of frequencies, making it more versatile for astronomy. Weber's protégé Robert Forward operated the first prototype, a small tabletop instrument, in 1972 at the Hughes Research Laboratories in California. Pioneering groups in Scotland and Germany went on to build interferometers with longer arms, making technological breakthroughs that at last allowed laser interferometry to surpass the bars in sensitivity. A turning point came in 1979 when Caltech lured the Scottish interferometry wizard Ronald Drever to its campus to build an instrument with 40-meter arms, the longest in its day.

FROM TEST BEDS TO TELESCOPES

But these were all test beds, not true gravity-wave telescopes. Detecting spacetime tremors requires interferometers with arms miles in length. The subatomic expansions and contractions are easier to measure over long distances. The longer the armspan, the greater the effect. When MIT joined forces with Caltech in 1983, they planned to build two large observatories.

But their funding did not arrive for nearly a decade. With no guarantee that a gravity wave would be detected, many astronomers and physicists waged a long, hard campaign against LIGO, declaring that the money would be better spent on surer scientific quests. But the potential of the science — not to mention strong politicking — eventually overrode those concerns.

If no gravity wave passes through one of the LIGO facilities, the two 2.5-mile arms have exactly the same length. Light beams reflecting within each arm will arrive at the detector out of phase, so they cancel each other out. If a gravity wave passes through, one arm will be lengthened and the other compressed by about the width of a proton. The changes in arm length cause the light to arrive at the detector partially in phase, so the beams add together to create a detectable signal.



With a final construction cost of $292 million (making LIGO the most expensive project ever funded by the National Science Foundation), the Hanford and Livingston observatories are separated by nearly 1,900 miles (3,000 km). The two are more like fraternal than identical twins. The Hanford facility actually houses two interferometers, which operate side by side through the arms. There is a full-length detector of 2.5 miles, as well as one half as long. The Livingston observatory has only the full-length interferometer. Each observatory, though, follows the same principles first established by Weiss, Drever, and others some three decades ago.

The mirrors, now two in each arm, are made of fused silica. Ten inches wide and four inches thick, each 22-pound (10-kg) cylindrical disk is polished to a smoothness that does not vary by more than 30-billionths of an inch. "If Earth were that smooth," notes LIGO's GariLynn Billingsley, who monitored the mirrors' production, "then the average mountain would not rise more than an inch." Such smoothness is a must for the light to be reflected over and over again to extreme accuracy. Each mirror is balanced on a single steel wire that is attached to a gallows-like frame. This support, in turn, rests on an isolation platform, not unlike a car's suspension system, to reduce seismic jitters by a millionfold.

Two observatories are needed to rule out local disturbances that might mimic a gravity wave at any one site, such as a passing garbage truck or seismic tremors. A gravity wave will pass through both observatories within 10 milliseconds of each other. In addition, the shape and size of the wave should be identical in both places.

LIGO will be most receptive to frequencies from 100 to 3,000 hertz, which is coincidentally the same frequencies our ears pick up as sound. You could actually listen to the signal, once it is electronically recorded. "It sounds like a hiss," notes LIGO's Albert Lazzarini. "Actually, it's a hiss with warbles in it due to the suspension. It's eerie, in some ways like whale songs." Gravity waves will at last be adding sound to our cosmic senses.

LIGO Detection Rates

Major upgrades scheduled to begin around 2005 should increase LIGO's sensitivity tenfold. These upgrades include a more powerful laser, better cushioning to shield against seismic vibrations, silica wiring, and pure sapphire mirrors. The black holes visible to LIGO will be in the range of a few dozen solar masses. The merger of two black holes that LIGO 1 at best could barely register at 300 million light-years should be readily detectable by LIGO 2 at 6 billion light-years. The numbers to the right display large ranges because they heavily depend on the theoretical assumptions, parameters that won't be known for sure until the first detections are made.

Event and Region of Space Scanned

LIGO 1	LIGO 2
Supernova (within our galaxy) 1 to 3 per century	Supernova (out to 60 million light-years) 2 to 3 per year
Black Hole/Black Hole Merger (out to 300 million light-years) 1 per 1,000 years to 1 per year	Black Hole/Black Hole Merger (out to 6 billion light-years) 10 per day to 10 per year
Neutron Star/Neutron Star Merger (out to 60 million light-years) 1 per 10,000 years to 10 per century	Neutron Star/Neutron Star Merger (out to 1.5 billion light-years) 1 per day to 1 per year
Neutron Star/Black Hole Merger (out to 130 million light-years) 1 per 10,000 years to 10 per century	Neutron Star/Black Hole Merger (out to 3 billion light-years) 10 per day to 1 per year

Computers, not ears, though, will be sifting through LIGO's data. The technique will be similar to the way in which military sonar experts search for the distinctive sound of a submarine amid the many noises of the sea. Essentially, as the data stream comes in, it will be compared to a "template," a theoretical prediction of what a gravity-wave signal might look like. Take, for example, the case of two neutron stars spiraling into each other. According to computer simulations, this system can produce many possible wave patterns because the signal depends on both the masses of the neutron stars and their orientation as viewed from Earth. To do a proper search, LIGO will have to continually compare its stream of data against some 20,000 to 30,000 possible signal patterns worked out by theorists.

Neutron star collisions may be the bread and butter of LIGO's trade. Once the detectors are sensitive enough to see hundreds of millions of light-years beyond Earth, they may detect a few mergers per year. LIGO will register the binary's final minutes, a sort of whine that rapidly rises in pitch, like the sound of a swiftly approaching ambulance siren, as the two city-sized balls of dense matter spiral into each other.

The biggest prize of all will be two black holes colliding. As the twirling holes are about to meet, spiraling inward faster and faster at speeds close to that of light, computer models predict that the whine will turn into a chirp, a birdlike trill that races up the scales in a matter of seconds. A cymbal-like crash, a mere millisecond in length, heralds the final collision and merger. The two black holes become one. A ring down, akin to the diminishing tone of a struck gong, follows as the new black hole swirls around like the fearsome tornado in *The Wizard of Oz*, wobbles a bit, and then settles down. Such a sighting would be the first direct evidence that black holes truly exist.

Other potential signals include the explosive burst of an asymmetric supernova, a murmur from the Big Bang itself, and the steady beat from a rotating neutron star. "But what if the strongest gravitational-wave signal," asks Lazzarini, "is a belch or burp that arrives sporadically? Then what? You have to assure yourself it wasn't just an amplifier problem or a bad wire." Those sorts of signals, the unexpected or irregular, will be the most difficult of all, "but they're also where the biggest surprises and most profound discoveries may lie," adds Lazzarini.

FIRST LIGHT

When new optical telescopes come on line, there is usually a celebratory "first light" event, the moment when the instrumentation is turned on and the first picture taken. LIGO's construction was completed last November, but its initiation was not so dramatic. Because its engineering and optics are so complex, LIGO will require a few years for its initial shakedown and calibration before all three interferometers — the two at Hanford, the other in Louisiana — can work in concert with one another. Then and only then can the search for gravity waves really begin, perhaps by late 2002.

LIGO researchers concede that their first detectors may not register a thing. For its critics, that made LIGO technologically unjustifiable and premature. LIGO, however, was built on the belief that scientists and engineers couldn't have found solutions without first building a full-sized facility to carry out the needed tests. At first, the two interferometers will be able to detect a change in spacetime as small as a millionth trillionth of a meter. Even then, the observatories will have only a small chance at observing an event. Over the years, upgrades will increase sensitivities more than tenfold, enabling LIGO to "feel" spacetime rumbles emanating from a variety of sources hundreds of millions or even billions of light-years distant. An advanced LIGO might register an event a day.

But what keeps LIGO researchers at work when no signal is guaranteed? "People take pleasure in solving the technical challenges," answers physicist Peter Saulson of Syracuse University, "much the way medieval cathedral builders continued working knowing they might not see the finished church. But if there wasn't a fighting chance to see a gravity wave during my career, I wouldn't be in this field. If you do this, you have the right stuff."

Marcia Bartusiak, a member of Astronomy's *editorial advisory board, adapted this article from her latest book,* Einstein's Unfinished Symphony, *which will be published this fall.*

Hear the Rumbles of Spacetime
Visit our website at www.astronomy.com to hear the "sounds" of gravitational waves.

LUMICON® High Performance

21 Years of Innovation!

WWW.LUMICON.COM **Visit our San Francisco Bay Area Showroom M-F 9-7, Sat 10-3**

NexStar 8
CELESTRON

Meet the Big Brother of the NexStar Family

Celestron introduces the NexStar 8 inch.

This scope has all the proven features of the NexStar 5, with more than twice the light grasp.

The Go-To Computer system contains 18,000+ objects. The NexStar 8 comes with a/c adapter or runs off 8 AA batteries (not included). All for an amazing $1899 plus shipping.

Other Celestron Telescopes at Lumicon

NexStar 5	$1199
Ultima 2000	$2699
Celestar Deluxe	$1699
Celestar	$1099
CM 1100– 11" SCT	$3199
Starhopper 8" Dob	$429
Starhopper 6" Dob	$339
C102-HD 4" Refractor	$499
FS114 Deluxe	$299
CR150 6" f/8 Refractor (NEW)	$1199

LOSMANDY GM8 & G11 Mounts

The G8 & G11 Mounts are among the finest mounts made in America. Both have dual-axis drive with periodic error correction built in. The GM8 can carry 30 lbs. of equipment, the G11 can carry 60 lbs. of equipment.

GM8 Mount with Tripod	$1499
G11 MountwithTripod	$1899

Other fine Losmandy accessories available.

LUMICON FILTERS - BEST IN THE WORLD BUT WHICH FILTER TO BUY?

LUMICON H-BETA
LUMICON OIII
LUMICON UHC
LUMICON DEEP-SKY

Lumicon Deep Sky Filters follow the classic broad band curve but offer the highest transmission of nebula lines of any such filter available. Lumicon Deep Sky filters block mercury and sodium vapor lamp emissions while letting thru all other parts of the spectrum. Deep Sky Filters are most useful for astrophotography (color & b&w) and CCD work. Deep Sky Filters are also useful visually, nebula offering the best contrast gain but galaxies, star clusters and dusty comets are also slightly enhanced.

1.25" Deep Sky Filter (fits most 1.25" eyepieces)	$99.50
48mm Deep Sky Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Deep Sky Filter (fits in series on back threads of SCT'S)	$199.50
2" Deep Sky Filter (fits 2" eyepieces and T-threaded accessories)	$199.50
72mm Deep Sky Filter (for the front of large telephoto lenses*)	$399.50

*step rings for other sizes available.

Lumicon Ultra High Contrast Filters have a narrow band pass that lets thru the two oxygen III and the hydrogen beta lines while blocking the remaining visual spectrum. The resulting filter yields high contrast views of all types of nebula. It is best used visually with any telescope of f/6 or longer focal ratio. The Ultra High Contrast Filter is not for photography.

1.25" Ultra High Contrast Filter (fits most 1.25" eyepieces)	$99.50
48mm Ultra High Contrast Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Ultra High Contrast Filter (fits in series on back threads of SCT'S)	$199.50

Lumicon Oxygen III filters isolate just the two oxygen III lines of the spectrum and block the remaining visual spectrum. The Oxygen III filter yields the maximum contrast gain possible on planetary nebula and most emission nebula. Views of the Veil Nebula and others with this filter are beyond words. The Lumicon Oxygen III Filter is for visual use only and is best suited for 6" and larger aperture telescopes with focal ratio of f/10 or faster.

1.25" Oxygen III Filter (fits most 1.25" eyepieces)	$99.50
48mm Oxygen III Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Oxygen III Filter (fits in series on back threads of SCT'S)	$199.50

Lumicon Hydrogen Beta Filters isolate just the hydrogen beta line of the spectrum and block the remaining visual spectrum. The Hydrogen Beta filter was created with a select number of low energy nebula in mind such as the Horsehead, Cocoon & the California nebula. In many instances the Hydrogen Beta filter is the **ONLY** way to see these nebula. The Hydrogen Beta Filter is a visual filter only, best suited to 8" or larger aperture telescopes with focal ratios of f/5 or faster.

1.25" Hydrogen Beta Filter (fits most 1.25" eyepieces)	$99.50
48mm Hydrogen Beta Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Hydrogen Beta Filter (fits in series on back threads of SCT'S)	$199.50

Special Pricing – Buy two or more Lumicon filters and get a DISCOUNT.

Filters normally priced at $99.50	pay only $92.50
Filters normally priced at $199.50	pay only $185.00

SKY VECTOR™ $349!!!

Includes Computer, Encoders, Hardware

LUMICON Sky Vector Features:

- "GUIDE" mode leads you to object
- Digital right ascension readout to 1 min.
- Digital declination reading to 10 arc/min.
- 4000 pulse (0.09 accuracy) encoders
- Polar Alignment NOT REQUIRED!
- Motor drive NOT REQUIRED!
- Just two stars to align
- Works Equally well for alt-azimuth telescopes like Coulter Odyssey and equatorial mounts like C-8, Meade 2080.
- No need to enter latitude, longitude etc.

SKY VECTOR I™ **$349.00**
NEW! With over 220 object memory including the 110 Messier and 58 best NGC objects.

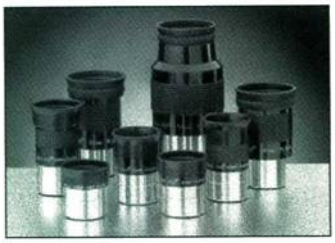
SKY VECTOR II™ **$399.00**
Over 3600 objects! Also included planets and full visual descriptions.

NGC-SKY VECTOR™ **$489.00**
12,000 objects! PC serial port NGC Sky Vector with IDENTIFY (Sky Tour) mode; 12,000 object memory including the corrected RNGC catalogue, IC catalogue, P&K planetary catalogue and much more.

NGC-Sky Vector
MODE
ENTER
UP
DOWN
LUMICON

Specify Telescope Type: Meade 4",8", 10",12" SCT, C-8, C-11, Odyssey 8", 10", 12", 17 1/2" alt-azimuth; Meade 6"-16" Dobsonian. Ultima 8", 9 1/4", 11" add $25.
C-14 add $75.

TELE VUE PRODUCTS



4X Powermate for 2" eyepieces	$265
5X Powermate boosts magnification 5x	$168
Ranger 70mm f6.8 apchromat w/1 1/4" diag.	$695
Pronto 70mm f6.8 w/1 1/4" diagonal.	$945
Tele Vue 85,85mm f/7 APO telescope	$1995
Bino Vue binocular w/2x correc.	$1030
Gibraltar mount with ash wood tripod	$530
8,11,15mm Plossl . $82 — **20,25mm**	$95
32mm Plossl, widest true field.in 1 1/4"	$110
55mm Plossl, widest possible field	$230
2.0x or 3.0x Tele Vue Barlow Lens	$105
2" Giant Barlow – 2x	$168
4.8mm Nagler 82° field, 1 1/4 " eyepiece	$175
7mm Nagler, 1 1/4 " eyepiece, 82° field	$220
9mm Nagler, 82° field 1 1/4 " or 2"	$240
12mm Nagler Type 4, 82° 1 1/4 "or 2"	$340
16mm Nagler Type II, 82° 1 1/4 "or 2"	$310
17mm Nagler Type 4, 82° 2" only	$370
22mm Nagler Type 4, 82° 2" only	$445
31mm Nagler Type 5, 82° 2" only	$595
2" Paracorr visual coma corrector	$235
3,4,6,8,10,14mm Radian,60° field	$228
15mm Panoptic 1 1/4", 68° field	$210
19mm Panoptic 1 1/4", 68° field	$240
22mm Panoptic 1 1/4"/2", 68° field	$280
27mm Panoptic 2", 68° field	$330
35mm Panoptic 2", 68° field	$365
NEW! Tele Vue 18mm radian, 60° field	$228.

Note: Tele Vue warranty may not be valid outside USA

Tele Vue's Newest!

Lumicon, always in the forefront bringing you the latest scopes and specials, brings you the newest scope from Tele Vue. The Tele Vue 102 (shown with optional Gibralter Mount) brings you the best of apochromatic optics in a longer 880mm f/8.6 length making it and even better choice for planetary viewing than previous releases.

Tele Vue 102 tube assembly only	$2050
Tele Vue tube holder for 102	$120
Tele Vue Ash Gibralter Mount	$530
Lumicon 2" Enhanced Aluminum Star Diagonal	$189.50
Lumicon 2"/1.25" Reducer	$25

We are Takahashi dealers
Call for lowest prices!

LUMICON
6242 Preston Avenue, Livermore, CA 94550

Phone Orders: Call our toll free ORDER LINE: 1-800-767-9576
EXPERT Information and Catalog Requests: Call 1-925-447-9570
FAX 1-925-447-9589 • Prices subject to change without notice
In stock items shipped within 2 business days

LUMICON®
Telescopes and Accessories

6242 Preston Avenue
Livermore CA 94550

Phone hours: M-F 9AM/7PM pst
Sat. 10AM/3PM pst 1-925-447-9570

ORDER TOLL FREE
1-800-767-9576

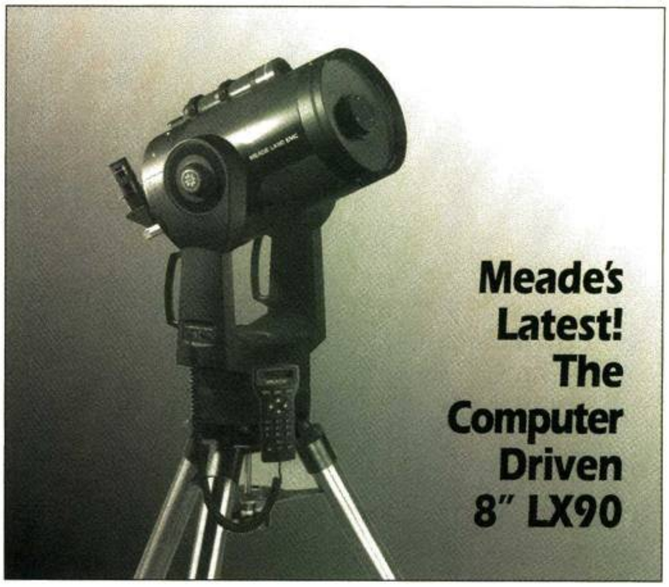
Lumicon Now Bigger, More Modern Than Ever

Anyone from San Francisco to Reno, Redding to Bakersfield is invited to visit our new, spacious facilities at 6242 Preston Avenue in Livermore, CA!

Lumicon has doubled its size and tripled its showroom space – providing a huge selection of Telescopes, Binoculars, Spotting Scopes and related optical accessories right on the floor. . . .And our inventory is growing all the time.

Even our hours are "bigger"
The showroom is now open until 7 p.m. weekdays
and 3 p.m. on Saturdays

Give us a call for directions. We're just two blocks off US 580



PENTAX EYEPIECES

Great Prices! Pentax 65°XL

Amazing performance! All have 20mm eye relief, adjustable helical eye guard, super multi-coatings, E.D. Glass

5.2mmF.L., 65°Apparent Field 1 1/4"	$279
7mm F.L., 65° Apparent Field 1 1/4"	$279
10.5mmF.L., 65°Apparent Field 1 1/4"	$269
14mm F.L., 65° Apparent Field 1 1/4"	$269
21mmF.L., 65°Apparent Field 1 1/4"	$269
28mm F.L., 55° Apparent Field 1 1/4"	$259
40mmF.L., 65°Apparent Field 2"	$299

Pentax Binoculars Spectacular 20mm eye relief

5x40mm Pentax PCFV Binocular	$169
7x50mm Pentax PCFV Binocular	$169
10x50mm Pentax PCFV Binocular	$184
16x60mm Pentax PCFV Binocular	$249

THE SCOPE REVOLUTION CONTINUES

Meade engineers have come out with their latest entry in the computer driven telescope revolution. The 8" LX90 combines Meade's proven optics with a dual metal fork arm mount and Autostar technology to produce a low priced, fully capable alternative. Both axis have a 4.9" worm drive for smooth motion. The 8" LX90 comes with the same tripod as the LX200. **All for a low $1695** (plus $95 shipping)

Other Fine Meade Telescopes at Lumicon

8"LX200 SCT with Tripod ($105p/s)	$2295
10"LX200 SCT with Tripod ($145p/s)	$2695
12"LX200 SCT with Tripod ($215p/s)	$3995
Wedge for 8" LX200(for photography) ($15p/s)	$139
Superwedge for 10"/12"LX200($35p/s)	$395
8" LXD500w/German eq. mt ($65 p/s)	$895
8"LX10 SCT w/RA drive/Tripod ($65 p/s)	$995
ETX 90EC Maksutov w/std.drives ($20p/s)	$595
ETX125EC Maksutov w/std.drives ($30p/s)	$895
DS80 EC w/dual drives ($45p/s)	$449
DS90 EC w/dual drives ($50 p/s)	$499
DS114EC w/dual drives ($45 p/s)	$399
DS127ED w/dual drives ($50 p/s)	$499

Meade Starfinders 6 -16"

6"f/8 Dobsonian Starfinder ($46P&S)	$249
6"f/8 Equatorial Starfinder ($79 P&S)	$499
8"f/6 Dobsonian Starfinder ($59P&S)	$349
8"f/6 Equatorial Starfinder ($89 P&S)	$599
10"f/4.5 Dobsonian Starfinder ($85 P&S)	$449
10"f/4.5 Equatorial Starfinder ($99 P&S)	$699
12.5"f/4.8 Dobsonian Starfinder ($95 P&S)	$795
16"f/4.5 Dobsonian Starfinder (frt. COD)	$1195
16"f/4.5 Equatorial Starfinder (frt. COD)	$2695

*All Starfinder telescopes shipped directly from Meade to the purchaser. Please add the indicated packing and shipping charge to the price. Slightly lower P&S for payment by check. Lumicon showroom prices are $50 to $100 higher.

See the Meade ad in this magazine for full descriptions. Starfinders are complete telescope systems with motor drive and finderscope (Equatorial only) and 25mm (48x) eyepiece. New DC motor runs on four AA batteries.

The Lumicon Solar Prominence Filter For Dazzling Solar Observing

The Lumicon Solar Prominence Filter allows the amateur to view prominences on the limb of the Sun as well as sunspots on the surface . . . but without the enormous cost of other Hydrogen Alpha filters on the market. Lumicon's Solar Prominence Filter comes complete with an energy rejection prefilter. A minimum effective focal length of 2000 mm is recommended, requiring the use of a 3X Barlow with most Newtonians and Refractors. Lumicon has masks to hold the prefilter in front of the telescopes listed below or you can make your own.

Solar Prominence Filter	$695
Off Axis Mask for 8" SCT	$ 68
Off Axis Mask for 10" or 11" SCT	$ 88
Off Axis Mask for 12" SCT	$ 99
Off Axis Mask for 10" or 11" SCT	$110
2" Accessory Adapter for SCT	$29

Meade & Celestron

Lumicon carries a full line of
Meade & Celestron Telescopes & Accessories
All at competitive prices & with FAST delivery
California residents add 8.25% sales tax

Anyone can sell you a telescope.

Authorized Meade Dealer

Meade ETX-90EC
$595
Meade ETX-125EC
$895
#497 Autostar
$149

Hardly a day goes by that we don't get a note or E-mail message like the one reprinted on the next page, or a call that goes something like this: "Your ads are right. Dealer so and so advertises low prices – but they don't have what I want in stock, they couldn't answer *any* of my questions, and they wanted my credit card number before they'd even *talk* to me. They said if I wanted to ask questions, I should call the manufacturer . . . and then they hung up on me!"

If you want the right telescope, you need more than a camera store clerk armed with only a price list and not a clue in the world about astronomy.

What you *really* need are people who will take the time to listen to what *you* need, people with years of experience using and selling telescopes, people who can help you get the most telescope for your dollar. That's exactly the kind of people you'll find at ***astronomics***.

Unlike camera stores and shopping mall gift shops, telescopes are our specialty at ***astronomics***, not just a sideline. We're a family-owned full-line telescope dealer – not just a few toy telescopes stuck off in the corner of some no-help department store, toy store, or gift shop as an afterthought. And, unlike department store clerks, we don't work on commission, so we won't try to sell you more than you need just to pad our paychecks.

We've been helping people choose the right telescope since 1979. We have the experience to help *you* pick the scope that fits your needs . . . *and your budget* . . . from the many Meade, Celestron, TeleVue, Takahashi, and Questar telescopes we keep in stock at discount prices from $99 to $27,995.

And we can usually ship your right telescope right away. We had 849 scopes *in stock* as we wrote this on 7/5, and over 1000 more on order.

astronomics. No hard sell. No guesswork. Just honest advice, the *right* scope, and a good price. Call us at (405) 364-0858 and find out for yourself.

We buy Meade by the ton . . . literally!

The day before this copy was written, we received 305 cartons from Meade – *3¼ tons* of scopes and accessories in one shipment. We don't know of many other dealers – if any – who regularly receive, or actually stock, Meade products in those quantities . . . *no matter what they claim.* But we do. Meade telescopes, eyepieces, filters, Magellan computers, CCD cameras, dew caps, Barlows, off-axis guiders, illuminated reticle eyepieces, counterweights, tele-extenders, T-adapters – we keep them all in stock.

We really do carry a large inventory.
Here's one of the ETX-125 areas in our warehouse. To see more, visit our website at www.astronomics.com.

We buy Celestron by the ton, too!

The week this was written, we got in 9791 pounds of Celestron scopes and accessories in a single shipment – 21 pallets, a full trailer load. The week before, we got a separate 3950 pound shipment from Celestron. We have hundreds of Celestron scopes in stock for immediate shipment, plus accessories galore. We don't know of many other telescope dealers – if any – who order and stock Celestron in those quantities. But we do.

Because we buy in large quantities, we can take advantage of special buys – extra savings that we pass on to you.

New 8" Meade LX90 lowers the cost of living it up!

Meade
8" LX90
$1695

You can live the good life of full size fully computerized go-to astronomy for less money than ever before with the new 8" **Meade LX90**.

The 8" LX90 SCT is only $1695, hundreds of dollars below the cost of a competitive 8" scope with fewer features. For full details, look for Meade's LX90 ad elsewhere in this magazine. The first LX90s should be reaching our warehouse about the time this magazine reaches your hands. We have many, many on order, so chances are good you'll be able to get a scope with little or no delay. While backorders *are* possible on this brand-new model, if Meade is shipping the LX90 for a dealer to keep in stock, chances are good we *have* it in stock.

Meade prices are about the same anywhere you call. So why order a Meade product from a dealer who charges your credit card, then makes you wait and wait until he finally gets around to ordering what you want? Not when you can usually get the Meade you want . . . right now . . . at the right price . . . right here at ***astronomics.***

Visit our redesigned and expanded website, now with secure on-line shopping, www.astronomics.com

We have 103 Meade ETX-125EC in stock!

Meade 5"
ETX-125EC
$895

At the time this was written (7/5), we had 103 **ETX-125EC** 5" Maksutov-Cassegrains in stock, with 400 more scheduled for delivery before the end of the year.

A picture showing just part of our 5" ETX inventory is shown in the column to the left. With more than 250 of these 5" Meades sold during the first six months of this year alone, the ETX-125EC is one of our most popular scopes.

And we don't just have ETX scopes. We have Autostar computers, hard cases, the new #887 heavy duty field tripod and wedge, eyepieces, electric focusers, filters, camera adapters, and more. If it's a Meade ETX-125EC, or a Meade accessory for the ETX-125EC – *or any Meade telescope* – chances are good we have it in stock.

3-day air shipping at no extra cost!

We ship by three-day air UPS from our warehouse to our East and West Coast customers at no extra charge above our regular shipping (except for scope cases, Dobsonians, dewshields, and a few other big items). No matter where you live in the 48 continental United States, your order should arrive by the third business day after we ship. UPS can't guarantee 3-day delivery in case of bad weather or during peak seasons, so UPS service guarantees do not apply to this limited time free upgrade if shipments are delayed.

A $50 instant rebate on 115 in-stock Celestron reflectors and refractors!

Celestron C114HD,
$349

Quantities limited

Not only do you get a $50 instant rebate off our regular low discount prices, but many come with a DC motor drive (normally $67.50), as a extra free bonus!

You'll save an extra $50 on Celestron's Firstscope 80 altazimuth or equatorial refractors, Firstscope 114 Deluxe or Premium reflectors, or C114HD premium reflector.

The 80mm **Firstscope 80EQ** refractor has an equatorial mount, adjustable height wood tripod, setting circles, slow motion controls, 6 x 30mm finder, 25mm eyepiece, and battery-operated drive for hands-free observing. $680 total list, it's only $299 after your $50 rebate.

The 114mm **Firstscope 114 Deluxe** reflector has an equatorial mount, adjustable height wood tripod, 5 x 24mm finder, 25mm and 10mm eyepieces, slow motion controls, setting circles, and battery-operated motor drive for hands-free observing. $610 total list, it's only $249 after your $50 rebate.

The **Firstscope 114 Premium** 114mm reflector has an equatorial mount, adjustable height metal tripod, 6 x 30mm finder, 20mm Plössl and 10mm SMA eyepieces, slow motion controls, setting circles, and battery-operated motor drive for hands-free observing. $680 total list, it's only $299 after your $50 rebate.

The **C114HD** 4.5" reflector with heavy-duty CG-4 mount also has a $50 rebate. $780 list, it's only $349 after rebate. A motor drive is an option on the C114HD.

And there's a $50 rebate on the **Firstscope 80AZ** altazimuth refractor, too. $570 list, it's only $249 after rebate.

Our free catalog helps you pick the right Meade, Celestron, Questar, Takahashi, or TeleVue scope.

For detailed information on individual products, visit our Web site. Or call us at (405) 364-0858, or e-mail us, for your *free* copy of our catalog AST. It covers all the scopes and accessories we stock – from Apogee, Bushnell, Canon, Celestron, JMI, Lumicon, Meade, Pentax, Questar, Rigel Systems, SBIG, Software Bisque, Takahashi, TeleVue, and more. We'll include our 8-page guide on how to pick the right scope and your discount prices on the 1000+ products we carry. (Sorry, U. S. sales only.) The catalog is yours for only the cost of a one minute phone call. The information we send will make it the most useful minute you'll ever invest in astronomy.

astronomics *Our 22nd year of friendly service, good advice, and money-saving prices.*

680 SW 24th Avenue, Norman, OK 73069
Toll-Free Order Line: **(800) 422-7876** Catalogs/Questions/Advice: **(405) 364-0858**

We'll sell you the *right* telescope.

Special Sale on the Celestron NexStar 5!

Celestron is running a special sale on the **NexStar 5**, but you'll have to call us for details. Special sale or not, you won't have any trouble getting a NexStar 5 from Astronomics. At the time this was written (7/5), we had 70 Celestron NexStar 5" f/10 go-to computerized Schmidt-Cassegrains in stock for immediate shipment.

NexStar 5
$1199

The NexStar 5 has a built-in go-to computer with 18,473 objects it can find for you, penlight-battery DC operation, sleek 21st century styling, a standard equipment AC adapter, and an eyeglass-friendly Star Pointer finder. And it's all in a compact package that's supremely user-friendly and portable.

Little scopes. Little prices. Suprisingly big performance.

Left, Meade ETX-60AT, **$299**; *above,* Meade ETX-70AT, **$349**

The new 60mm **Meade ETX-60AT** and 70mm **ETX-70AT** refractors hit a new low in pricing for fully computerized scopes . . . and a new high in value! For less than the cost of many eyepieces alone, you can have a complete scope – with dual axis motor drives, two eyepieces, built-in go-to computer with 1471 stars and objects in its memory for pushbutton astronomy, and more!

Ideal as starter scopes, as second scopes for casual astronomy, as vacation scopes, as scopes for the kids . . . these Meade scopes are winners!

We stock Pentax eyepieces.

From 5.2mm to 40mm, we stock all of the Pentax wide field (55° to 65°) ED eyepieces. Each has a rotate-to-adjust-eye-relief eyecup and a long 20mm eye relief perfect for those who wear eyeglasses. Premium eyepieces . . . sensible prices.

5.2 or 7mm 1.25" 65°	**$259⁰⁰**
10.5, 14, or 21mm 1.25" 65°	**249⁰⁰**
28mm 1.25" 55°	**239⁰⁰**
40mm 2" 65°	**259⁰⁰**

This Questar costs almost $1000 per inch!

For many people, the mere thought of a 3.5" aperture scope that *starts* at $3395 is enough to curl their toes. But for those who want the best small telescope made, a 3.5" Questar for $3395 is a bargain.

Questar 3.5" Standard **$3395**

Solar filters for eyepiece and finder, built-in Barlow, two ultra-premium eyepieces, a velvet-lined hard case, a star chart on the slide-on lens shade with a Moon map beneath – all are standard on a Questar . . . and unavailable from the competition.

Want a Questar, the premier portable telescope? We stock them.

CCD? We have Apogee LISÄÄ, Meade, *and* SBIG.

Since we stock almost all available models of the Apogee LISÄÄ, Meade, and SBIG CCD cameras, autoguiders, and accessories (like the new **Apogee LISÄÄ** 659 x 494 pixel guider and imager to the left and the 1534 x 1020 pixel **SBIG ST-8E** self-guiding imager to the right), the chances are good you won't have to wait to get the camera of your choice. Here are the various CCD cameras and guiders that we normally keep in stock and their prices.

Apogee LISÄÄ autoguider or camera	$1495⁰⁰
Apogee LISÄÄ color camera	1395⁰⁰
Apogee LISÄÄ megapixel camera	2595⁰⁰
Apogee LISÄÄ megapixel color	2595⁰⁰
Apogee LISÄÄ guider + color	2690⁰⁰
Apogee LISÄÄ guider + megapixel	$3890⁰⁰
Meade 201XT autoguider	395⁰⁰
Meade 208XT autoguider or camera	495⁰⁰
Meade 216XT 16-bit camera	695⁰⁰
Meade 416XTE camera/guider pack	1995⁰⁰
Meade 1616XTE camera/guider pack	6495⁰⁰
SBIG ST-4 autoguider or cameraa	890⁰⁰
SBIG ST-5C track/accumulate camera	895⁰⁰
SBIG ST-237 track/accumulate camera	1195⁰⁰
SBIG ST-6B track/accumulate camera	3025⁰⁰
SBIG ST-7E self-guiding camera	2950⁰⁰
SBIG ST-8E self-guiding camera	7350⁰⁰
SBIG ST-9E track/accumulate camera	3950⁰⁰
SBIG STV digital video camera/guider	1595⁰⁰
SBIG STVD digital video w/LCD screen	1995⁰⁰

Our Takahashi sales are up 225% this year.

Why are more and more people buying more and more Takahashi from us? Is it because we stock more Takahashi than just about anyone else?

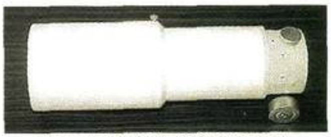
While many people swear *at* the long delivery times quoted by some premium refractor manufacturers, most knowledgeable astronomers swear *by* the unsurpassed optical quality and fast delivery of the Takahashi apochromatic refractors we keep in stock.

From the 2.4" **FS-60C** OTA at $829 to the 5" **FS-128** OTA at $5249, we stock Takahashi fluorite apochromatic doublet refractors, mounts, and accessories – so we can deliver scopes *fast.* We can also special order larger scopes with 1-3 month delivery times. Why wait for 1-3 *years* to get your apo refractor or mount from another manufacturer? You can be usually be viewing through a truly fine Takahashi apo only a few short days after you order from us.

Takahashi FSQ-106N OTA (4" f/5), **$3475**, on an EM-2 mount, **$2229**. Also shown is the FS-102 4" f/8 OTA, **$2349** w/o finderscope.

We stock complete Takahashi apo scopes on USD mounts with dual-axis 50x sidereal slewing, as well as apochromatic optical tubes to install on your own mount.

We also stock the 22" long Takahashi **FSQ-106N** 4" 4-element f/5 dual fluorite apo refractor OTA, with retractable lens shade, at $3475. It's a great travelling scope. We had 5 in stock as we wrote this on 7/5.


Takahashi FCL-90 ***Sky 90*** OTA (3.5" f/5.6), shown with dew shield retracted, **$2279**

Arriving this fall is the unique Takahashi **FCL-90 *Sky 90*** 90mm refractor. With its self-storing dew shield retracted, as shown above, this remarkable scope is less than 14" long! It makes a great traveller you can stow away anywhere.

If you want a great scope, and you want it *now,* it's got to be a Takahashi from ***astronomics***.

TeleVue? We keep it in stock.

TeleVue TV-85, in stock, **$1995**

Hardly a week goes by that **TeleVue** doesn't send us copies of warranty cards filled with the glowing comments written by our our customers about the TeleVue scopes they bought from us. But we don't need to be reassured about TeleVue quality. We expect nothing but praise for TeleVue, which is why we stock them in depth. At the time this was written (7/5), we had 36 TeleVue scopes in stock, *including four TV-101,* and 45 more on order.

Pronto, **Ranger**, **TV-85**, **TV-101**, the new **TV-102** optical tube assembly, the brass **Renaissance** – all are built to the same uncompromisingly high optical and mechanical standards. Their short focal lengths give you an observing flexibility many other scopes lack. Each has the ability to go from very low power wide angle views (as low as 9x in some cases, with a wide 5.7° field) to very high power observing, all without losing optical quality (one test report said they used an amazing 89x per inch of aperture on TeleVue's least expensive model, the Ranger).

In addition to scopes, we also stock TeleVue eyepieces, Barlows, and accessories in depth. Be it a Plössl, Nagler, Radian, Powermate, Panoptic, tunable top Paracorr, Gibraltar or Tele-Pod mount, Qwik-Point finder, and more, if it's a TeleVue product, the chances are very good we have it in stock.

A CM1400 for how little?

Celestron CM1400

We made another large quantity buy on Celestron's 14" Schmidt-Cassegrain **CM1400** German equatorial mount telescopes – and we got them at a very special price.

The normal retail on the CM1400 is $5299 *and up.* But, once again, our price is too low to print. You'll have to call us at (800) 422-7876 to discover our actual selling price on this seriously big telescope. While the quantities we have available at this price are large, they're not infinite, so don't miss out on this special buy. Call now.

> Just wanted to thank you guys for your great order processing and shipping. I was pleasantly surprised when the order arrived so soon.
>
> Keep up the good work, you're the best. Thanks again.
>
> **Customer Quote of the Month #103**

24-Hour FAX line: (405) 447-3337 Our e-mail address: questions@astronomics.com

Our multiple award-winning Internet address: www.astronomics.com

Our phone lines are open 10 to 7 CST, Monday thru Friday, and most Saturdays from 12 to 5.

Mastercard, Visa, Discover, American Express. U. S. sales *only*.

No credit card surcharge. $6.95 minimum freight. All returns less freight. Restocking fees apply to returns for credit and to merchandise returned used or damaged.

sky Show

october

Aurorae may join Jupiter and Saturn on October evenings.

by Martin Ratcliffe and Alister Ling

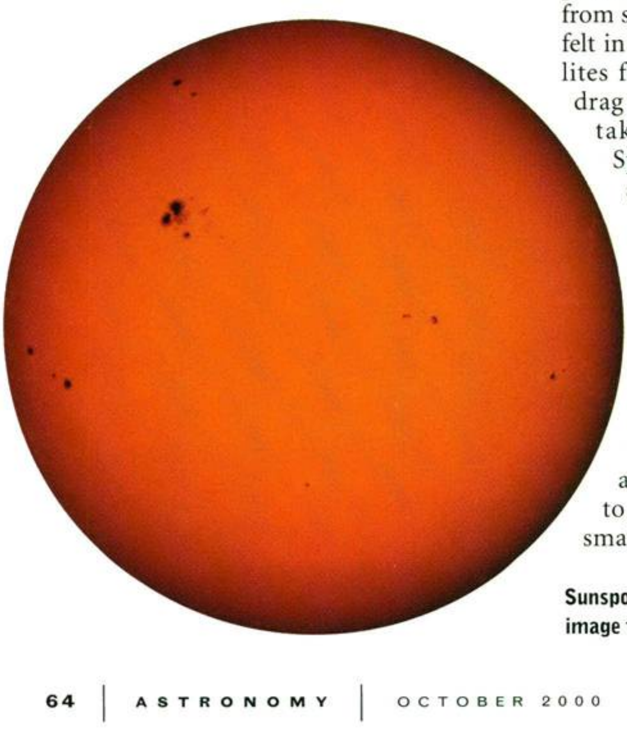
When an eruption from the sun heads toward Earth, we can see beautiful aurorae. Jody Baird

▶ A common misconception exists that the northern lights are more common in fall or winter compared to summer. In reality, it just gets dark earlier in colder months, which increases your chances of seeing an aurora. In the summertime you may have to wait until after 10 P.M. to be sure that any light you see is really an aurora and not the last vestiges of sunlight.

We're currently at the peak of the 11-year sunspot cycle. One brilliant event already graced our skies on April 6th, when lucky observers across the southern states and southern Europe caught a glimpse of a red-tinged sky. Another auroral event may still be in the works.

Your first clue to an impending aurora is when a large, active group of sunspots rotates into view. Sunspots are related to the sun's coronal activity, and when the corona suddenly lurches, a CME (coronal mass ejection) is hurtled into space. If Earth is in the line of fire, a grand auroral display can be triggered from the pounding taken by magnetic fields in Earth's rarified upper atmosphere. Even if aurorae are not spotted from such an outburst, other effects are felt in Earth's upper atmosphere. Satellites feel an increase in atmospheric drag and drop lower in their orbits, taking years off their lifetimes. Spacecraft can require corrective actions. In addition, radio blackouts occasionally occur.

If you want to check for sunspots, remember to observe the sun only with a proper filter. Although nowadays, you don't even need a solar telescope. Point your Internet browser to http://www.spaceweather.com. There you will find a current image of the sun similar to what you would see through a small telescope, and you can access links to get up-to-date reports on the current solar activity and likelihood of flares. To see the position of the auroral oval itself, check out http://www.sec.noaa.gov/pmap/. If the area of activity is ballooned out toward you, look north as soon as darkness falls.



Sunspots pepper the photosphere in this image taken on March 4, 2000. William R. Grunden

If you want to see some jaw-dropping real-time pictures and movies of the outer corona and solar surface, then go to http://sohowww.nascom.nasa.gov/data/realtime-images.html.

Naturally there are plenty of other fascinating events to watch this month. Jupiter and Saturn rise mid-evening; the variable star Mira reaches maximum; and a high-numbered asteroid is unusually bright. If you want to give the kids an extra treat on Halloween night, bring out your scope to do some sidewalk astronomy while you're handing out the candy.

October 2000

5 First quarter moon is at 6:59 A.M. EDT

6 The moon is at apogee (251,140 miles from Earth), 3:03 A.M. EDT
Mercury is at greatest eastern elongation (26°), 6 A.M. EDT

7 The moon passes 1.3° south of Neptune, 2 A.M. EDT

8 The moon passes 1.5° south of Uranus, 4 A.M. EDT

9 Asteroid Pallas is in conjunction with the sun, 6 P.M. EDT

13 Full moon is at 4:53 A.M. EDT

16 The moon passes 1.6° south of Saturn, 2 A.M. EDT
The moon passes 2° south of Jupiter, 8 P.M. EDT (page 70)

19 The moon is at perigee (229,979 miles from Earth), 5:59 P.M. EDT

20 Last quarter moon is at 3:59 A.M. EDT

21 Jupiter passes 5° north of Aldebaran, 1 A.M. EDT
Orionid meteor shower peaks (page 72)

23 Asteroid Nausikaa is at opposition, 9 A.M. EDT

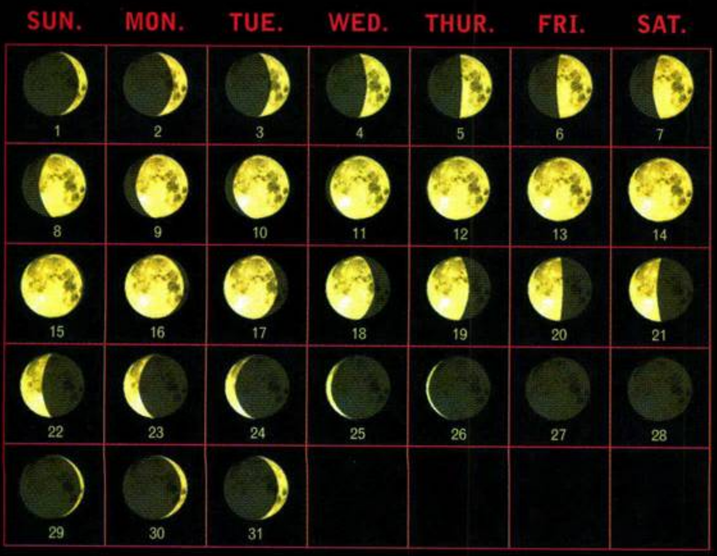
24 The moon passes 3° north of Mars, 1 A.M. EDT

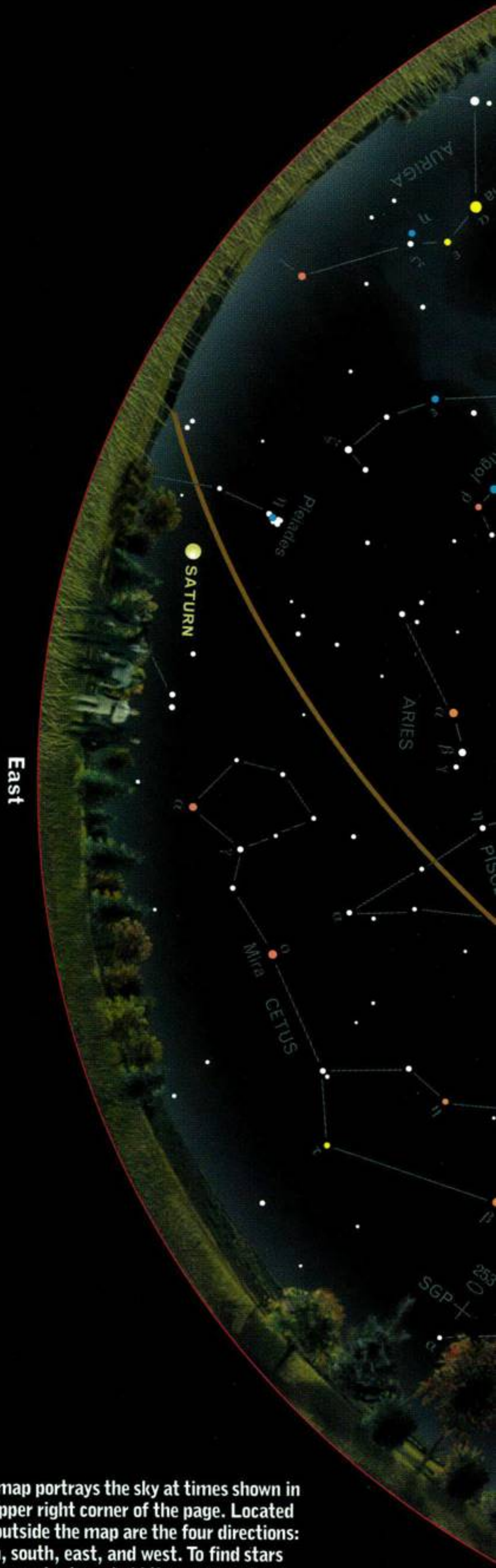
26 Venus passes 3° north of Antares, 6 P.M. EDT
Asteroid Urania is at opposition, 9 P.M. EDT

27 New moon is at 3:58 A.M. EDT

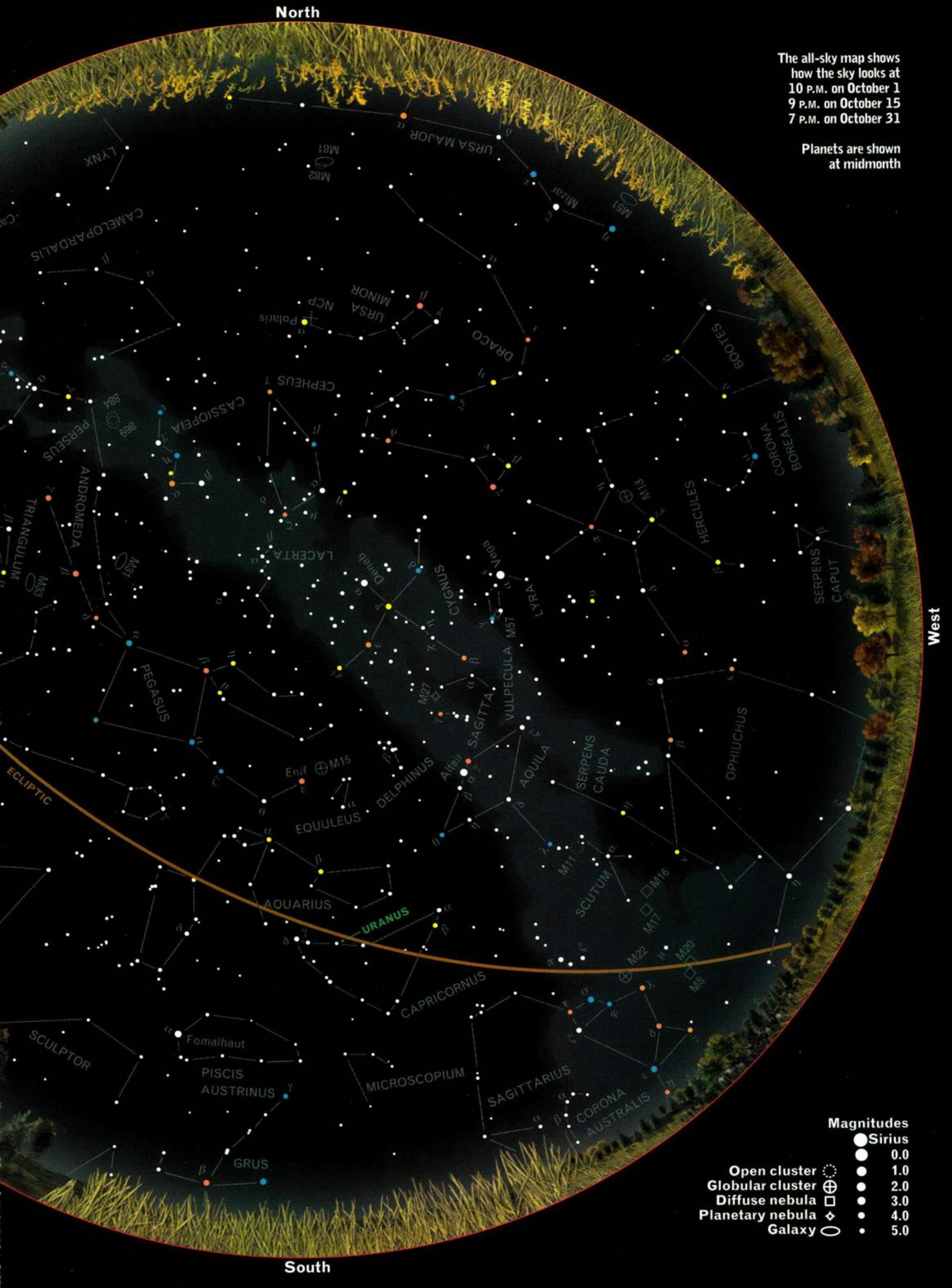
29 Mercury is in inferior conjunction, 9 P.M. EST

30 The moon passes 4° north of Venus, 3 A.M. EST


SUN.
MON.
TUE.
WED.
THUR.
FRI.
SAT.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31


East
AURIGA
Pleiades
SATURN
ARIES
PISC
Mira
CETUS
SGP

This map portrays the sky at times shown in the upper right corner of the page. Located just outside the map are the four directions: north, south, east, and west. To find stars above your horizon, *hold* the map overhead and orient it so a direction label matches the direction you're facing. The stars above the map's horizon now match what's in the sky.

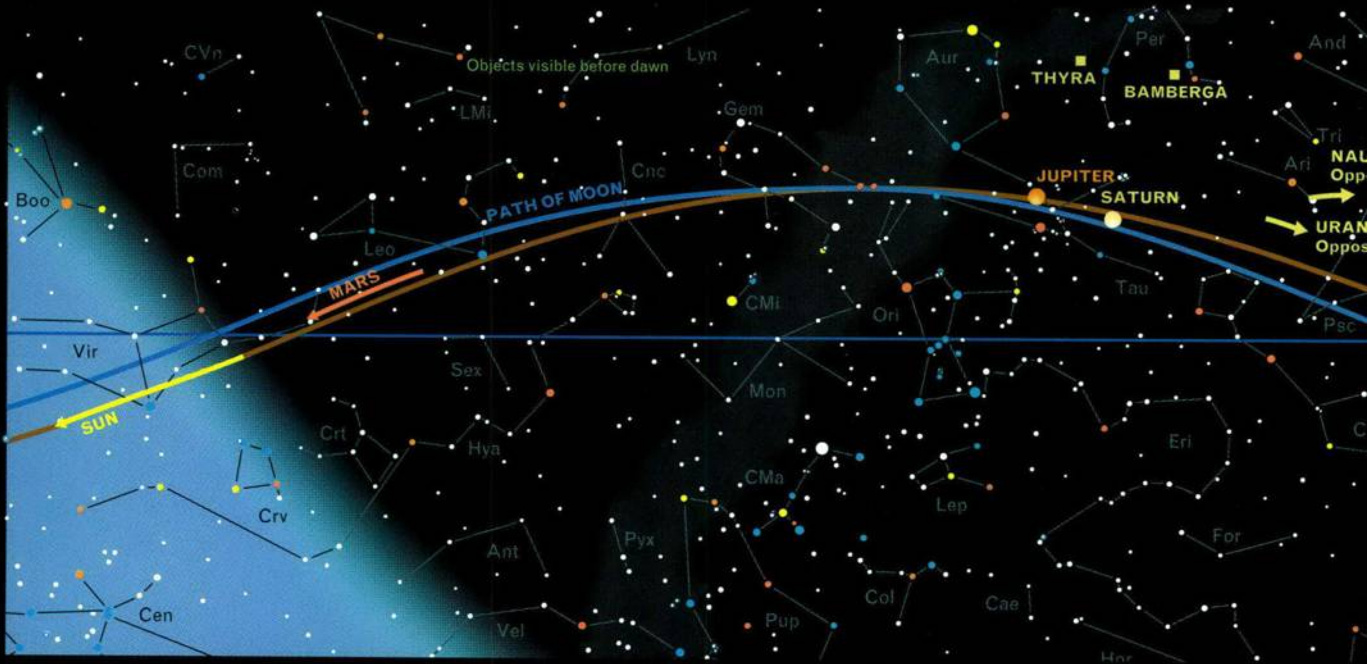

North
LYNX
URSA MAJOR
M81
M82
Mizar
M51
CAMELOPARDALIS
URSA MINOR
NCP
Polaris
DRACO
BOOTES
CEPHEUS
CASSIOPEIA
PERSEUS
884
869
ANDROMEDA
TRIANGULUM
M33
M31
LACERTA
Deneb
CYGNUS
Vega
LYRA
M57
HERCULES
M13
CORONA BOREALIS
SERPENS CAPUT
West
PEGASUS
M27
VULPECULA
SAGITTA
Altair
AQUILA
SERPENS CAUDA
OPHIUCHUS
ECLIPTIC
Enif
M15
DELPHINUS
EQUULEUS
M11
SCUTUM
M16
M17
AQUARIUS
URANUS
CAPRICORNUS
M22
M20
M8
SCULPTOR
Fomalhaut
PISCIS AUSTRINUS
MICROSCOPIUM
SAGITTARIUS
CORONA AUSTRALIS
GRUS
South
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
Open cluster
Globular cluster
Diffuse nebula
Planetary nebula
Galaxy

The all-sky map shows
how the sky looks at
10 P.M. on October 1
9 P.M. on October 15
7 P.M. on October 31

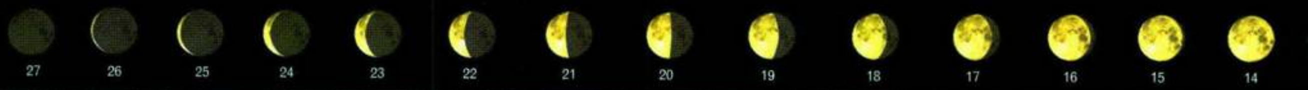
Planets are shown
at midmonth

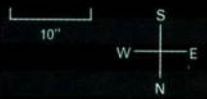
Path of the Planets

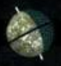
This map unfolds the entire night sky from evening (at right) until sunrise (at left). Arrows and squares show the movements and locations of solar system objec

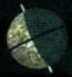

CVn
Objects visible before dawn
Lyn
LMi
Com
Boo
Cnc
Gem
Aur
Per
And
THYRA
BAMBERGA
Tri
Ari
NAU
Opp
JUPITER
SATURN
URAN
Oppos
PATH OF MOON
Leo
MARS
CMi
Ori
Tau
Psc
Vir
SUN
Sex
Mon
Crt
Hya
Eri
CMa
Lep
Crv
Ant
Pyx
For
Cen
Vel
Pup
Col
Cae
Hor
C

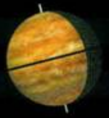
To locate the moon in the sky, draw a line from the phase


27
26
25
24
23
22
21
20
19
18
17
16
15
14





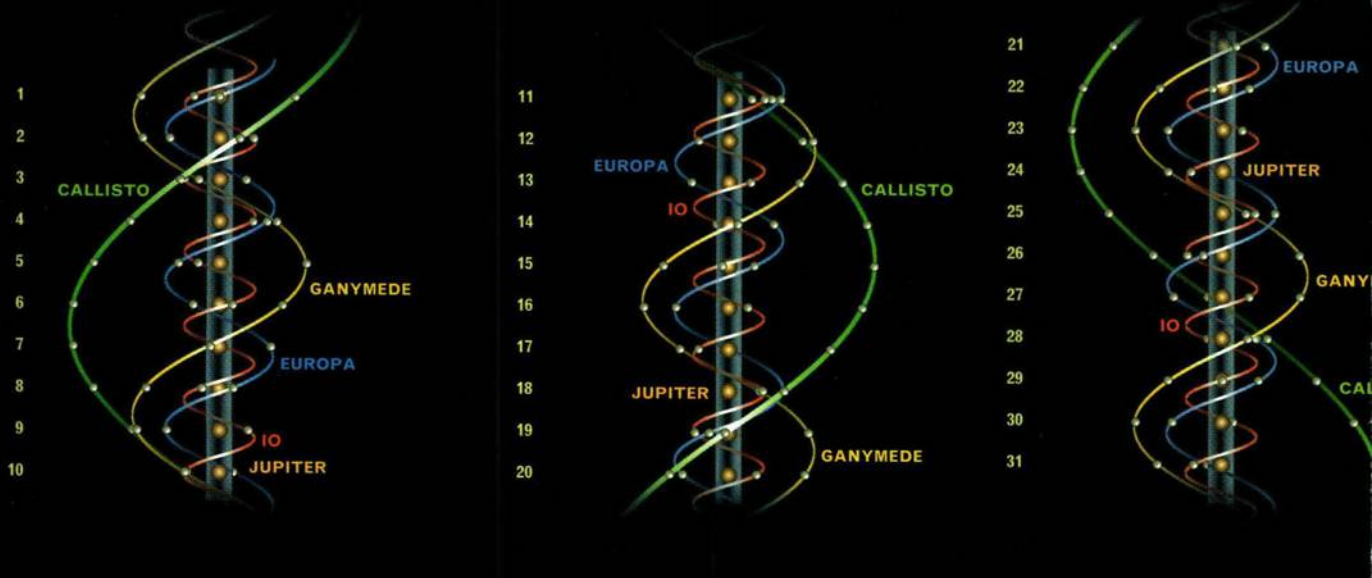




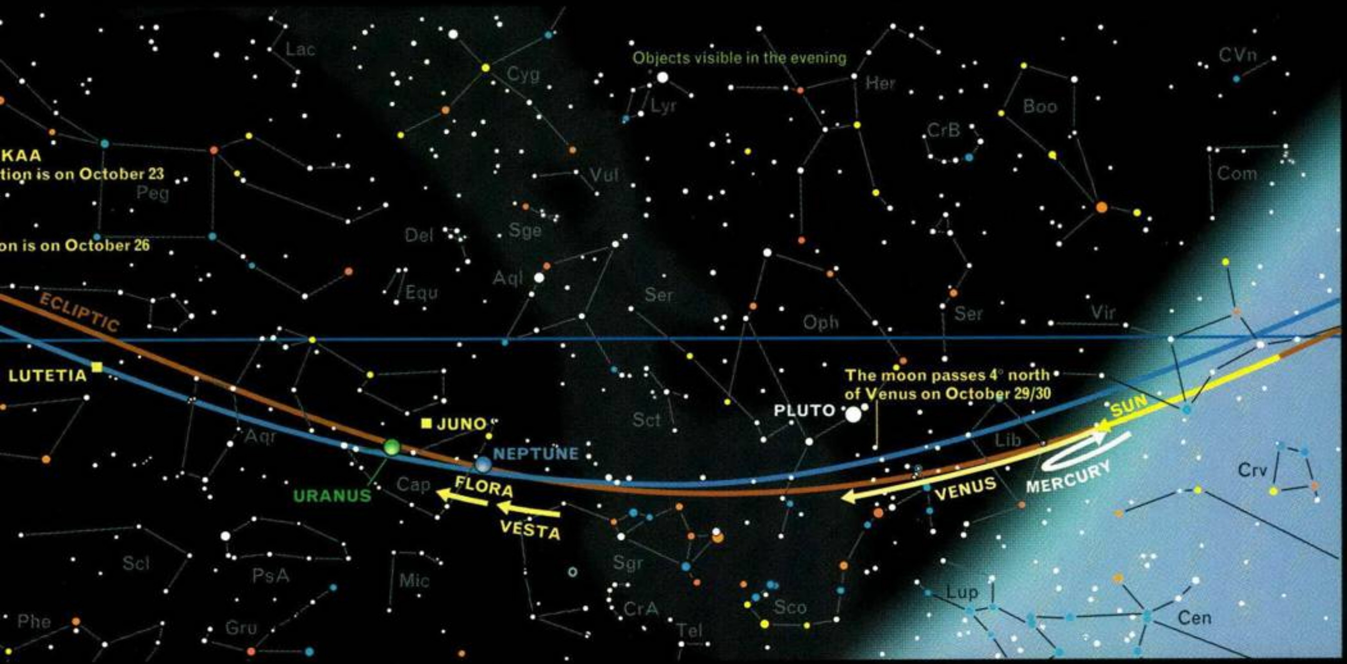
PLANETS	**MERCURY**	**MERCURY**	**VENUS**	**MARS**	**JUPITER**
Date	October 1	October 15	October 15	October 15	October 15
Magnitude	0.0	0.3	–4.0	1.8	–2.7
Angular Size	6.2"	8.0"	12.6"	3.9"	45.7"
Illumination	69%	41%	83%	97%	99%
Distance (AU) from Earth	1.083	0.844	1.323	2.389	4.312
Distance (AU) from Sun	0.457	0.401	0.728	1.664	5.024
Right Ascension (2000.0)	13h59.7m	14h46.2m	15h29.0m	11h16.2m	4h37.5m
Declination (2000.0)	–14°41'	–19°30'	–19°46'	6°06'	21°08'

Jupiter's Moons

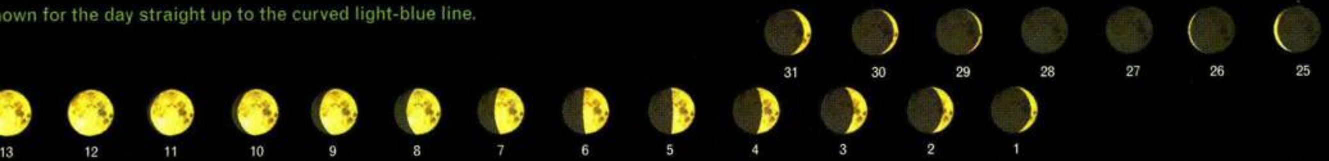
Dots display positions of Galilean satellites at 4 A.M. EDT on date shown. South is at top to match the view in a telescope.

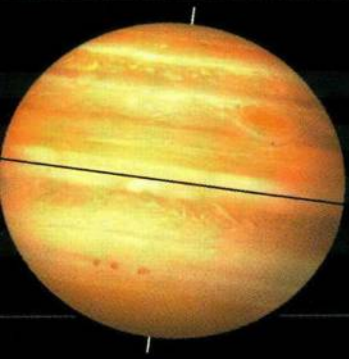


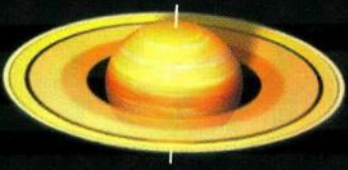
during the month.


Lac
Cyg
Objects visible in the evening
Lyr
Her
CrB
Boo
CVn
Com
KAA
tion is on October 23
Peg
Vul
Del
Sge
on is on October 26
Equ
Aql
Ser
Oph
Ser
Vir
ECLIPTIC
LUTETIA
The moon passes 4° north of Venus on October 29/30
PLUTO
SUN
Sct
JUNO
NEPTUNE
Aqr
Lib
URANUS
Cap
FLORA
VENUS
MERCURY
Crv
VESTA
Scl
PsA
Mic
Sgr
Phe
Gru
CrA
Tel
Sco
Lup
Cen

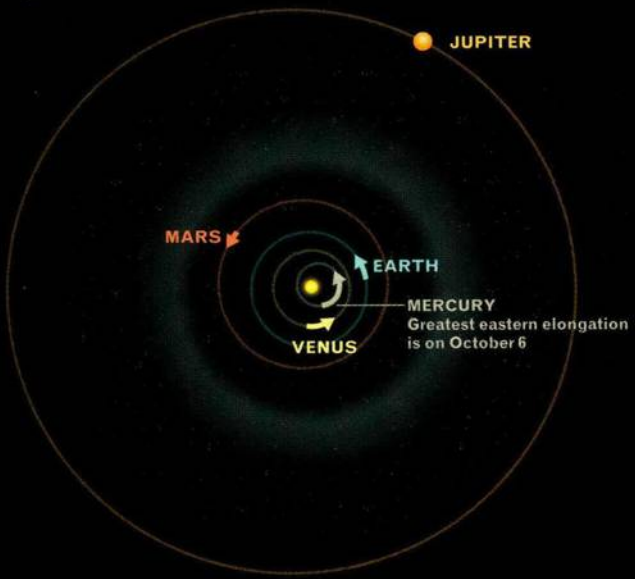
own for the day straight up to the curved light-blue line.


31
30
29
28
27
26
25
13
12
11
10
9
8
7
6
5
4
3
2
1



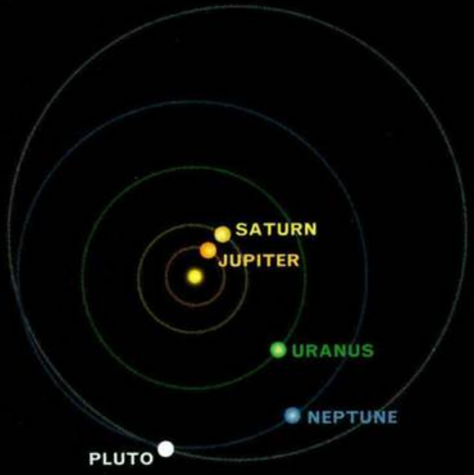


SATURN	URANUS	NEPTUNE	PLUTO
October 15	October 15	October 15	October 15
−0.2	5.8	7.9	13.9
20.0"	3.6"	2.3"	0.1"
100%	100%	100%	100%
8.322	19.509	29.890	30.945
9.127	19.951	30.110	30.312
3h53.5m	21h18.5m	20h24.2m	16h43.5m
17°55'	−16°27'	−19°07'	−11°41'


JUPITER
MARS
EARTH
MERCURY
Greatest eastern elongation is on October 6
VENUS

The Planets in Their Orbits

Arrows and dots show planets' positions during the month.


SATURN
JUPITER
URANUS
NEPTUNE
PLUTO

The Sky's Brightest Variables

Maybe this will be Mira's year to shine. Mira the "Wonderful" is predicted to reach its maximum early this month. Usually it adds a modest 3.5-magnitude star to the vacant central area of Cetus the Whale, but this year it could crest at 2nd magnitude, brighter than anything in this section of sky.

Of course, there's a chance Mira won't even make it to 4th magnitude, but we can always hold out hope. Back in 1799, the famous observer William Herschel witnessed Mira rival Aldebaran in brightness.

Algol, the variable known as the Demon Star, is the anchor point for our jump to a galaxy cluster in deep space. If you start observing on the evening of the 22nd or 25th, you'll immediately notice that Algol is hard to find because it's a full magnitude fainter than normal. Over the next few hours it will slowly brighten as its invisible companion star ends its partial eclipse.

The Perseus Galaxy Cluster

A few nudges of the telescope east of Algol swarms a veritable congestion of galaxies. In the middle of this maelstrom lies a monster galaxy, NGC 1275. Violent reactions occur in this magnitude 11.9 cD galaxy. The strongest radio source in Perseus, it is also prolific in x rays.

The Perseus Galaxy Cluster is a challenging deep-sky object. Preston S. Justis

Wait until the last 10 days of the month for the moon to move well out of the picture and find a nice dark-sky location. In an 8-inch scope at low power you should notice a distinctly fuzzy, gray form. This giant galaxy at the cluster's core is considerably farther from us than the Virgo Cluster, so the individual objects will be both fainter and smaller. On the plus side, in a big scope the galaxies crowd into the field of view.

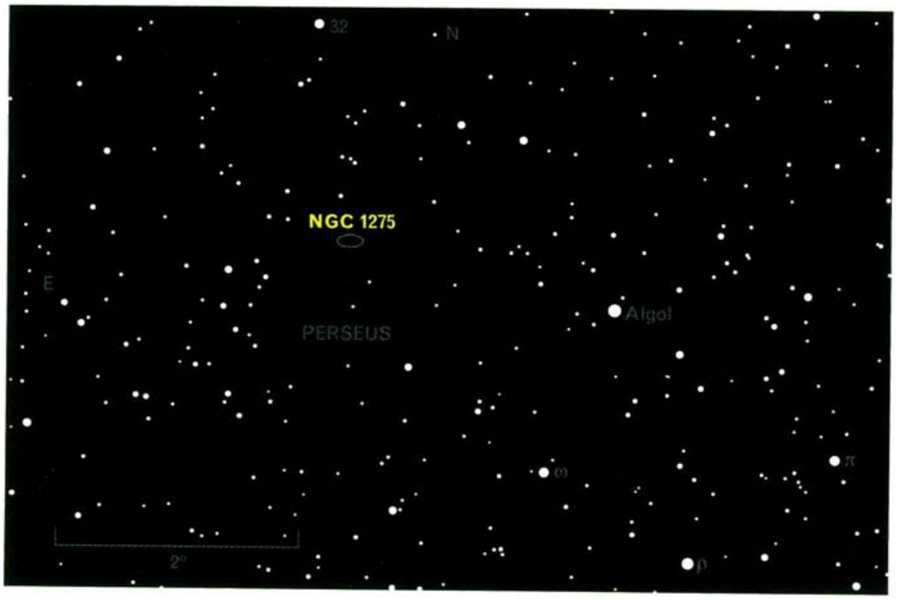
To find NGC 1275, point your scope at Algol. Shift it northward 1 moon-width (30'), turn off the clock drive, and come back in 8 minutes and the galaxy will be centered in your field.

Boost the magnification to at least 150x and spend a good 10 to 15 minutes getting accustomed to the darker field. Seek out its fainter companions. A mere 5' to the west lies the more diffuse NGC 1272.

At this point, you will find it useful to put a dark cloth over your head and eyepiece in order to keep out any stray lights. A practical fellow in my astronomy club breathes through a snorkel so he doesn't accidentally fog the eyepiece while exhaling.

With an 8 or 10-inch scope, more inexperienced deep-sky observers might be hitting their limit at two galaxies. Practice and patience pays off with 3 or 4 additional faint glows.

If possible, ask someone with a 16-inch or larger scope to show this cluster to you. It's an incredible experience: As your vision adapts to the darkness, fainter galaxies keep popping into view like ghostly grapes on an invisible vine. As your eye darts around, averted vision will continue to pick up many faint smudges and background stars. There are more than 35 galaxies in a 30' field of view.



sky Show

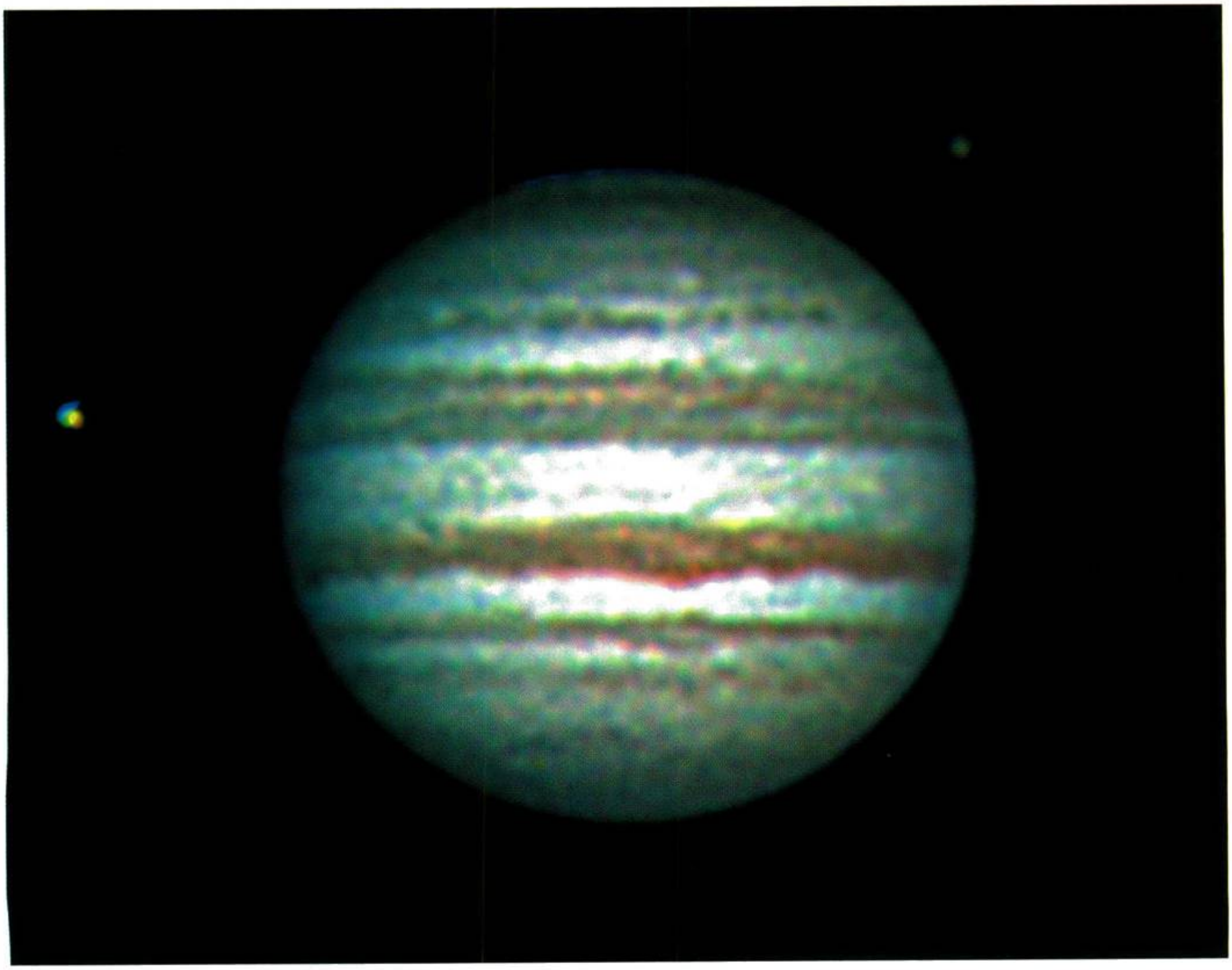
Bright Planets Dominate the Evenings

Jupiter and **Saturn** put on the finest planetary display during late evenings in October. The pair of glittering giant planets lies among the stars of Taurus the Bull. Saturn lies 6° south of the fine star cluster called the Pleiades, and Jupiter lies 4° north of the brightest star in Taurus, Aldebaran. Saturn rises first but Jupiter is the brighter of the two, dominating the late evening eastern sky after it rises around 10 P.M. local time. Saturn shines at magnitude –0.1 and brightens another two-tenths of a magnitude by October 31. Jupiter brightens by a similar amount this month but starts out on October 1 as the brightest night-sky object other than the moon, shining at magnitude –2.6. By midnight both planets are more than 30° above the eastern horizon and well placed for some serious telescopic observing.

The advantages of observing Jupiter are many — first, it's the largest planet in the solar system, and second, Jupiter is at its closest to Earth during the next three months. Many features can be seen in the jovian atmosphere through almost any telescope. As Jupiter's rapid rotation carries the varied features across its face, our grandstand view can keep us occupied at the eyepiece for hours. Jupiter approaches its largest diameter as seen from Earth, growing from 44" to 47" across. This is more than double the apparent size of Saturn's globe, which only manages a 20" diameter.

Saturn's fine display of rings is the crowd-pleaser — perhaps everyone's favorite solar system sight. Because Saturn is still a month away from opposition, our view of the planet is off to one side of the line joining Saturn and the sun. For telescopic observers of Saturn this means that we can still see the shadow of the planet fall behind the globe and onto the rings — a feature that gives the planet an added three-dimensional appearance.

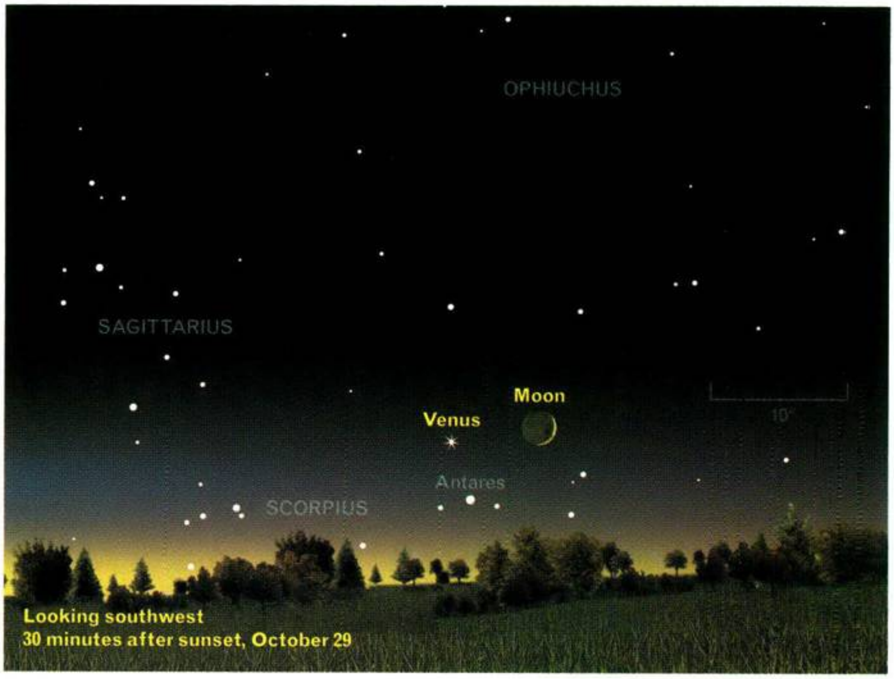
Saturn stands less than 3° to the left of a large gibbous moon when the two rise on October 15 for North American observers. One night later the moon



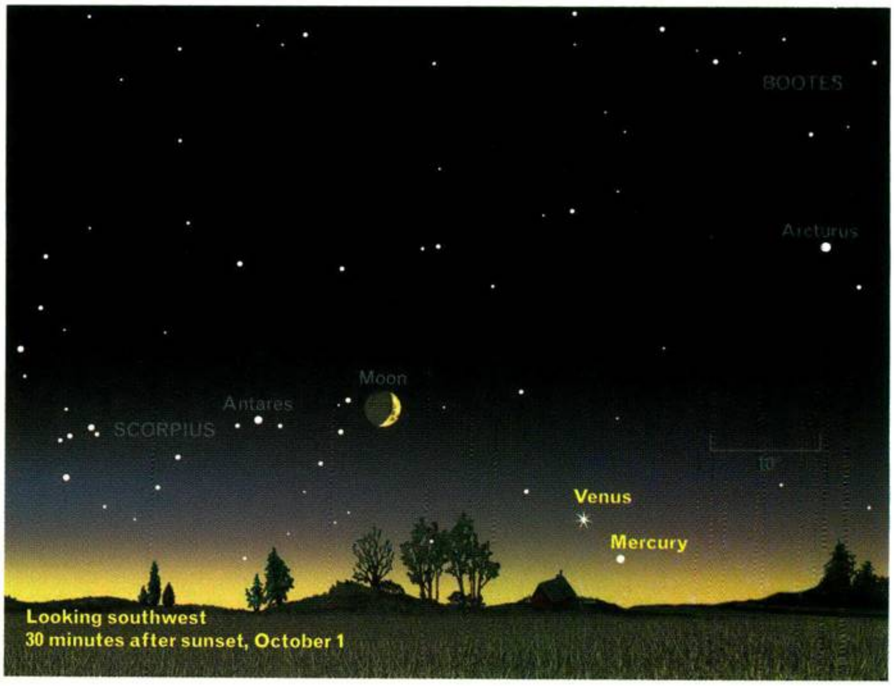
The moons of Jupiter appear in the most modest of telescopes. David Hanon moves to form a delightful trio with Jupiter and Aldebaran.

While you're waiting for Jupiter to rise, watch **Venus** make a brief appearance right after sunset. It reaches magnitude –4.0 this month but never strays far from the sun. Consequently it sets very early. By the end of October Venus sets two hours after sunset. Check out the lovely 3-day-old crescent moon just off to the right of Venus on October 29. One day later the waxing crescent moon lies 7° above Venus, which continues to lie low in the southwest. The phase of Venus is visible through small scopes and appears quite different from the moon's on this night. Eighty-seven percent of the globe of Venus is illuminated on October 1, shrinking to 80 percent by October 31.

During the first week of October fleeting **Mercury** hangs near Venus. On October 1 Mercury lies 5° west, or to the lower right, of Venus. By October 6 the separation has increased by a degree and Mercury is at its greatest eastern elongation and shines at magnitude 0. Following this date Mercury begins to fall back into the solar glow and fade in brightness, reaching inferior conjunction with the sun on October 30.



Looking southwest
30 minutes after sunset, October 29



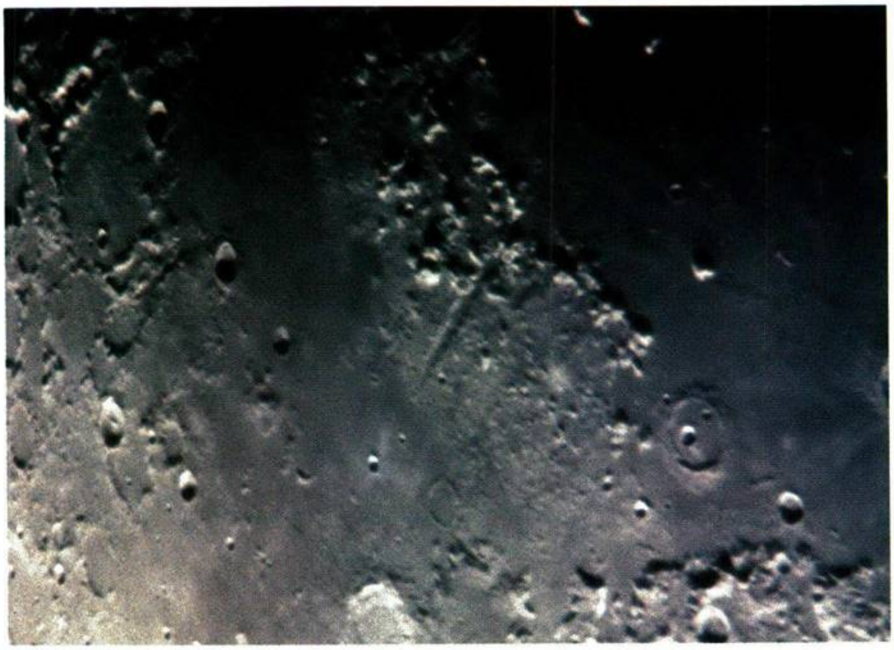
Looking southwest
30 minutes after sunset, October 1

Uranus and **Neptune** lie among the dim stars of Capricornus the Sea Goat. The entire constellation lies due south and is at its highest just an hour after sunset during October. Uranus is an easy object in binoculars, while Neptune is best spotted using a telescope. Uranus was the first planet discovered using a telescope — in the year 1781 by William Herschel. Prior to that date only the planets out to Saturn were known. The discovery of Uranus began a series of discoveries about the seventh planet from the sun that continues to this day. You can locate the planet using binoculars. It currently shines at magnitude 5.8 and lies less than 1° west of Iota (ι) Capricorni, a naked-eye star in the upper midsection of Capricornus shining at magnitude 4.2. This star makes picking up Uranus a breeze.

Neptune is wandering a little more than 1° west-southwest of Omicron (ο) Capricorni, a magnitude 6.7 star near the western end of Capricornus. Neptune shines at magnitude 7.9 all month. While binoculars can pick up the distant planet, only a telescope reveals Neptune's planetary nature. The planetary disks of both Uranus and Neptune are tiny — 3.6" and 2.2" respectively.

Mars passes from Leo into Virgo on October 24, and on the same day a waning crescent moon lies 4° east. The returning Red Planet rises about three hours before the sun. On October 30 Mars passes two-thirds of a degree north of Beta (β) Virginis, a magnitude 3.6 star. Mars glows at a relatively dim magnitude 1.8, and it won't improve before the end of the year.

Meteors and Moons



The Alpine Valley slices through the northern reaches of the moon. Jean Dragesco

The Alpine Valley

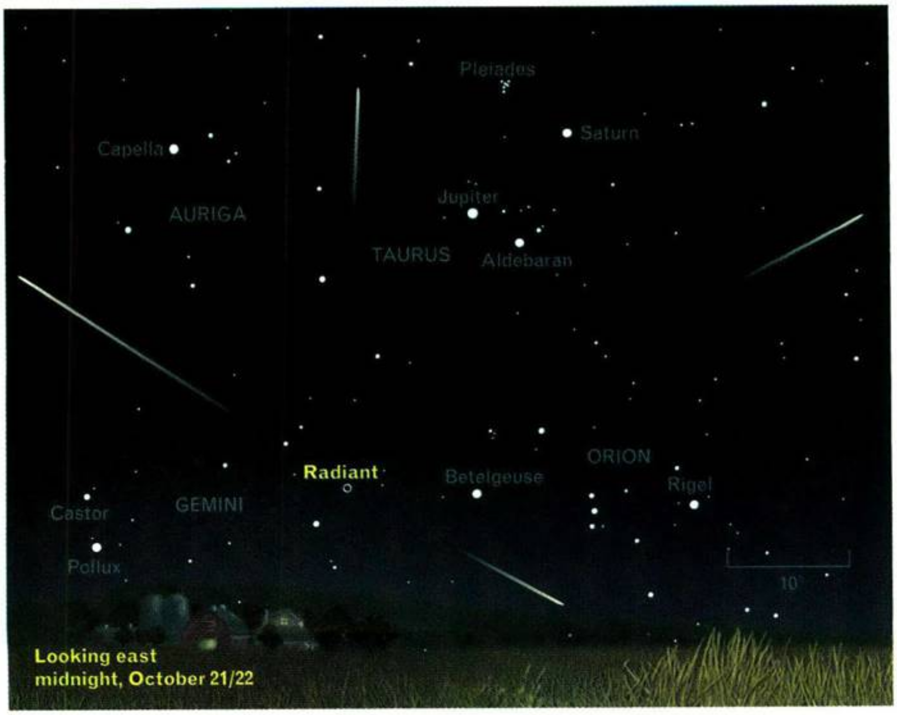
South of Mare Frigoris, not far from the crater Cassini and to the east of the giant walled plain Plato, lies one of the most spectacular valleys on the surface of the moon. The Alpine Valley cuts an 80-mile-long swath through the giant mountain chain of the Alps that forms a curved border with Mare Imbrium. At the western end of the valley, giant mountains rise up from the lava plains of Mare Imbrium, most notably Mont Blanc, which reaches 11,800 feet. This group of mountains practically blocks off the western end of the valley.

Moving east, the valley rapidly widens into a lava-filled plain, then narrows again. Close study of the valley with large telescopes reveals small crater pits along the valley's southern wall. Farther east the valley widens and lofty hills jut out onto the valley floor. At the eastern end, entering Mare Frigoris, the valley narrows and then disappears in a cluster of small hills. Photographs of the valley from orbit reveal a sinuous rill running the length of the valley, but few observers have recorded this feature from Earth. Watch for the sun rise over the Alpine Valley between October 7 and 8 — the spectacular shadows created by the dramatic topography will change with the hour.

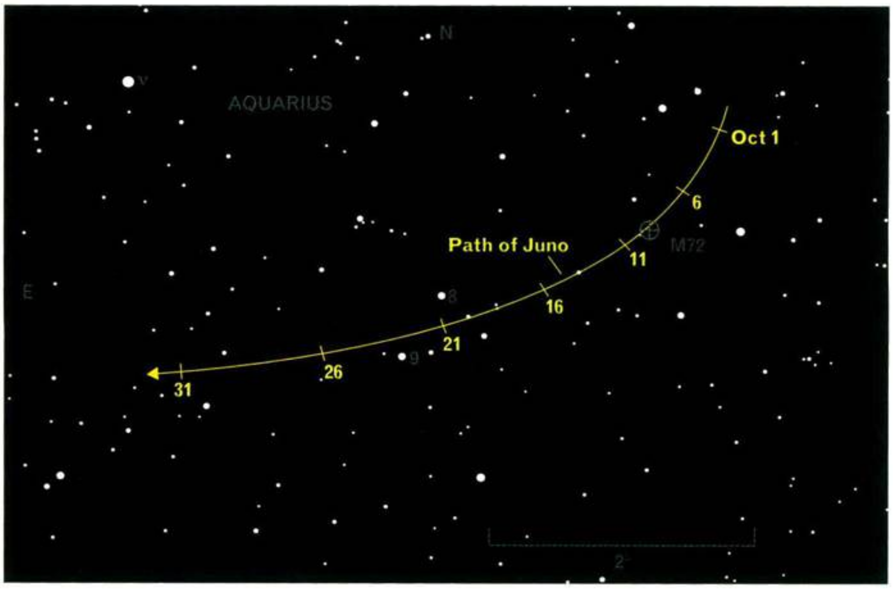
Catch a Falling Star

Early in the month the Draconid meteors, linked to Comet Giacobini-Zinner, are active. The shower only erupts around the years of the comet's closest passages. Giacobini-Zinner reached perihelion in November 1998, and during the previous month a mini-storm produced the equivalent of 700 meteors an hour over a period of a few minutes. This kind of activity is highly unlikely, but it is worth watching the skies around October 8 for any unusual activity. The radiant in Draco is high above the horizon during the early evening. If that cluster of meteoroids is still hanging around, Earth reaches the same point in its orbit as the 1998 event at approximately 9 P.M. EDT on Saturday night, October 7.

One of the most famous displays of the year is the Orionid meteor shower — one of two annual showers linked to Halley's Comet. At the peak of activity on October 21, the radiant lies in the raised club of Orion and rises before midnight. Rates are better after midnight, but the bright glow from a rising last quarter moon will blot out all but the brightest meteors. Meteors from this shower are very fast, at about 35 miles per second, and roughly half of them leave persistent trains. Rates can reach up to 15 to 20 per hour — but expect less than this due to moonlight.



Looking east
midnight, October 21/22



An Uncommon Rock

An asteroid that doesn't get much attention becomes our target this month. Asteroid 324 Bamberga was discovered in 1892 in Vienna by Johann Palisa. Dr. von Brandt, the mayor of Bamberg, Germany, named the asteroid during a conference. At 150 miles (240 km) across, Bamberga is one of the larger asteroids roaming the solar system. Its orbit ranges from 1.8 to 3.6 times the Earth-sun distance (AU or astronomical unit), and this month it comes within 1 AU of Earth at about magnitude 9.4. In short, Bamberga just doesn't get much brighter than this.

The easiest time to hunt for Bamberga is in the second half of the month, when it lies only a couple degrees from the bright variable star Algol. As a bonus, the moon is out of the evening sky. Even with the map, you might not be sure of a positive identification. Do a quick sketch of the starfield, then wait another night to see that it's moved. On the 29th, you should be able to see it slowly recede from a 6th-magnitude star.

Juno to Graze Globular

It's rare to witness a bright asteroid pass in front of a bright deep-sky object. On the evening of the 9th, the asteroid 3 Juno will appear to graze the northeastern flank of the globular star cluster M72 in Aquarius. At magnitude 9.4, Juno will be far brighter than any of the distant cluster's supergiants, which glow dimly at about 14th magnitude. Be wary of the star playing decoy just to the southeast of M72.

Asteroid Dust All Aglow

As countless as the grains of sand on all the world's beaches, vast numbers of minuscule dust specks permeate the plane of the ecliptic. As insubstantial as they are, you can see them with the unaided eye on the crisp morning of a moonless October dawn.

Together the tiny motes scatter sunlight into a skyglow called the zodiacal light (similar to the way city air pollution brightens the sky around the sun). The light gets its name because the glow stretches along the same path the planets move on, the zodiac (or ecliptic). The diffuse light forms a large, slightly slanted pyramid, with the base on the horizon. The bottom should lie near Leo, currently home to Mars and Regulus, and the peak should taper up toward the Beehive cluster in Cancer.

The zodiacal light is one of those "can't see the forest for the trees" phenomena. Once you recognize it, it's surprisingly easy. The moon scatters its own interfering light between the 12th and 26th. You'll need to scan the eastern sky about 90 minutes before sunrise, before the first glows of true dawn. Remember, you're looking for a veil-like object that is quite large, covering two full spans of your outstretched hands.

The Milky Way (stretching upward at left) can be confused with the zodiacal light (diverging from the Milky Way to the right). Mace Hooley

---

Martin Ratcliffe is Director of Theaters at the Exploration Place in Wichita, Kansas. Alister Ling is a meteorologist working for Environment Canada in Alberta.

Over 12,000 Product Descriptions Online!

Order Online @
# www.focuscamera.com

TOLL FREE FAX
800-TO-FOCUS
OVERSEAS FAX
718-437-8811

4419-21 13TH AVE.
BROOKLYN, N.Y. 11219
888-221-0828

N.Y. STATE & OVERSEAS
718-437-8810
E-MAIL ADDRESS
orders@focuscamera.com

MEADE
ADVANCED PRODUCTS

MAKSUTOV-CASSEGRAINS

ETX SCOPES

Exquisite, Diffraction-Limited Imaging in an advanced, ultra portable telescope system!

ETX-90EC Includes:
w/Dual-Axis Drive,
8x21 Erect-Image Viewfinder
& 26mm Plossl

ETX- 125EC Includes:
Dual-Axis Drive,
8x25 Right-Angle Viewfinder
& 26mm Plossl

Optional #497 Autostar controller with GO TO capability **$149**

ETX 90EC 1250mm f/13.8	$595
ETX 125EC 1900mm f/15	$895
LX-50 7" f/15 w/Std Equatorial Wedge	$1,795
LX-200 7" f/15 w/Heavy Duty Fork Mount	$2,795
#883 Deluxe ETX Field Tripod (90/125)	199.00
#64 Photo Adapter (90/125)	34.95
#825 8x25 Right-Angle Viewfinder (90)	49.95
#880 Equatorial Table Tripod (90)	29.95
#881 Equatorial Table Tripod (125)	59.95
#932 45° Erecting Prism (90/125)	49.95
#1244 Electric Focuser (90)	119.95
#1247 Electric Focuser (125)	119.95
#774/#775 Hard Case for ETX	CALL

PICTOR CCD IMAGERS
416-XTE & 1616-XTE

With New Kodak Blue-sensitive CCD *Chip*

For the beginner, or for the most advanced observer, the real CCD *revolution is here!*

201-XT Autoguider/Imager	395
208-XT Autoguider/Imager	495
216-XT Autoguider/Imager	695
416-XTE Autoguider/Imager	1,995
1616-XTE Autoguider/Imager	6,495
Off Axis Guider f/CCD	89.95
616 Color Filter System f/416, 1616-XT	695
616A Color Filter System f/216	695
520 Electronic Relay f/201, 208, 216, 416, 1616	94.95
541 AC Adapter f/201, 208, 216	36.95
542 AC Adapter f/416, 1616	94.95

EYEPIECES

MODIFIED APOCHROMATIC

9, 12, 25, 40mm 1.25"	37.95	9, 12, 25, 40mm .96"	29.95

PLOSSL SERIES 3000

5, 6.7, 9.5, 16, 25mm 1.25"	49.95	40mm 1.25"	79.95

SUPER PLOSSL SERIES 4000

6.4, 9.7, 12.4, 15, 20, 26mm 1.25"			79.95
32, 40mm 1.25"	99.95	56mm 2"	199.95

PLOSSL SERIES 4000 SUPER WIDE ANGLE

13.8mm 1.25"	139.95	18mm 1.25"	149.95
24.5mm 1.25"	179.95	40mm 2"	299.95
32mm 2"	239.95		

PLOSSL SERIES 4000 ULTRA WIDE ANGLE

4.7mm 1.25"	169.95	8.8mm 1.25"/2"	239.95
6.7mm 1.25"	199.95	14mm 1.25"/2"	299.95

ILLUMINATED RETICLE EYEPIECE SYSTEMS

	Wireless	w/Cord
Plossl 9mm 1.25"	149.95	129.95
MA 12mm 1.25"	99.95	79.95
MA 12mm Astrometric 1.25"		119.95
Plossl 25mm CCD Framing Ocular 1.25"		129.95

BARLOWS

#122 2x Telenegative 1.25"	44.95
#126 2x Short Focus 1.25"	44.95
#127 2x-3x Variable 1.25"	56.95
#134 Achromatic .96"	44.95
#140 2x Apochromatic 1.25"	74.95

SCHMIDT-CASSEGRAINS

In virtually every country in the world where serious telescopes are sold, more Meade LX-200's are sold than all competing models combined.

Standard-equipment includes:
- Superb optics
- Automatic GO TO capability
- LX-200 High-Precision Pointing
- Permanently-Programmable Smart Drive
- 9-Speed Dual-Axis Electronics
- Field operation

LX-10 8" w/Hand Controller	$995
LX-50 8" f/10	$1,395
LX-50 10" f/10	$1,695
LX-50 10" f/10 w/Super Wedge	$1,895
LXD 300 SERIES 203 8" f/10	$795
LXD 500 SERIES 203 8" f/10	$895
LX-200 8"	$2,295
LX-200 10"	$2,695
LX-200 12"	$3,995
LX-200 16"	CALL
LX-200SC 12" f/2.2 Schmidt-Camera	CALL
Magellan I #2014 f/LX-10	375
Magellan II #2024 f/LX-50	495

ED APO REFRACTORS

300 SERIES

102 Achromatic 4" f/9	$595

500 SERIES

102 Apochromatic 4" f/9	$1,649
102 Achromatic 4" f/9	$695
102ED 4" f/9 w/Mount, Tripod & Acc.	$2,795
127ED 5" f/9 w/Mount, Tripod & Acc.	$3,295
152ED 6" f/9 w/Mount, Tripod & Acc.	$4,995
178ED 7" f/9 w/Mount, Tripod & Acc.	$5,995

Optical Tube Only	CALL
#1207 Electric Focuser	144.95
#1664 Electronic Drive	349
#1697 Computer Drive System	749
#1702 Dual Axis Drive System	195
#1812 Electronic DC Adapter	89.95

ACCESSORIES

#62 T-Adapter f/SCT	26.95	Off Axis Guider	79.95
#931 45° Hybrid Erct Prsm	43	f/6.3 Focal Reducer	129.95
Basic Tele-Extender	29.95	**#1205** Focuser	CALL
Camera Adapter 1.25"	29.95	**#1206** Focuser	CALL
Camera Adapter .96"	27.95	6x30 Viewfinder	CALL
Variable Tele-Extender	39.95	8x50 Viewfinder	CALL
DEW SHIELD & DUST COVER	Call	**#607** 25' Cigarette Adpt	25
Piggyback Bracket f/SCT	Call	55 Manual DEC Control	75

Variable Projection Camera Adapter 1.25"	39.95
#927 45° Erect Image Diagonal Prism .96"	42.95
#928 45° Erect Image Diagonal Prism 1.25"	42.95
#929, #930 2" Mirror Diag. w/Eyepiece Holder f/1.25"	99.95
Tube Balance Weight System f/All SCT	CALL
#531 Motor Drive w/Auto Tracking f/4500 Newtonian	CALL
Interface Cable f/LX-200	25
EPOCH 2000sk Sky Software 3.5" Disks	149
EPOCH 2000sk Sky Software CD	179
EPOCH 2000ip Software 3.5" Disks	199

FILTERS

#905 Variable Polarizer 1.25"			49.95
Moon Filter ND96 1.25"	16.95	4 Piece Set 1.25"	49.95
Individual Filters	14.95	Skylight/Dust Seal	44.95

* Nebular	Oxygen III	Broadband*	Narroband*
#908 1.25"	99.95	79.95	89.95
#910 2"	159.95	119.95	129.95
#911 Rear Cell	149.95	99.95	119.95

STARFINDERS

Dobsonian Deluxe Package Add $49.95

SPECIAL EYEPIECE OFFER!
At time you order any Meade Equatorial, get a 9.7mm Series 4000 Plossl **for only $29.95!**

	Dobsonian	Equatorial
6" f/8 w/26mm Plossl	$349.95	$649.95
8" f/6 w/26mm Plossl	$449.95	$749.95
10" f/4.5 w/26mm Plossl	$599.95	$879.95
12" f/4.8 w/26mm Plossl	$895.95	-
16" f/4.5 w/26mm Plossl	$1,195	$2,695

Magellan I #2010 f/Dobsonians	295
Magellan I #2011 f/Equatorial 6", 8", 10"	295
Magellan I #2012 f/Equatorial 16"	295
Magellan II #2018 f/Equatorial 6", 8", 10"	495
Magellan II #2019 f/Equatorial 16"	595

DIGITAL ELECTRONIC SERIES

The Most Important Advancement in Begining and Intermediate Telescopes in 100 Years!

- Object tracking
- Altazimuth mountings
- Electronic controller (EC)
- Autostar computer controller
- Meade StarNavigator software

ACHROMATIC REFRACTORS

DS-60 60mm (2.4"), 700mm f/11.8	$199
DS-70 70mm (2.8"), 700mm f/10	$249
DS-80EC 80mm (3.1"), 900mm f/11.3	$449
DS-90EC 90mm (3.5"), 1000mm f/11.1	$499

NEWTONIAN REFLECTORS

DS-114EC 114mm (4.5"), 910mm f/8	$399
DS-127EC 127mm (5"), 1020mm f/8	$499
Optional Autostar Controller	$99.95

SPECIALS!

MEADE

390 3.5" 90mm, 1000mm f/11	$229.95
MTS-SN6 Telescope	CALL

CELESTRON

25mm Ocular 1.25" (93307)	$19.95
19mm Ultima WA 1.25" (93358)	$79.95
GP-C8 (Demo) #91514-GP	CALL
ULTIMA 9 1/4 9 1/4"	$2,199
C5+ 5", 1250mm f/10	$899
PixCel CCD Camera	$895.95
Fastar 8 2032mm (8") f/10	$2,089.95
Ultima 11 2800mm (11") f/10	$2,749
500mm Mirror Lens #81005	$239.95

BINOCULARS & SPOTTING SCOPES

CELESTRON

BLOWOUT!

8-32x50 Zoom $114.95

9x63 Ultima	CALL	20x80 Giant	368.95
8x32 Ultima	188.95	10x50 Regal	CALL
8x56 Ultima	268.95	8x40 Pro	114.95

MEADE

8x25 Safari Pro	180	10x25 Safari Pro	200
7x36 WA Safari Pro	170	8x42 WA Safari Pro	180
10x42 Safari Pro	190	10x50 WA Safari Pro	200
7x42 WA Rainforest Pro	480	8x56 Rainforest Pro	500

Nikon. SPORT OPTICS

You'll Never See Things Quite The Same Again!

7x35 E 245 8x30 E	257	10x70	1048.95
8x32 E Superior	CALL	7x50 Prostar	721.95
10x42 E Superior	CALL	10x40 Lookout IV	102.50
12x50 E Superior	CALL	10-22x50 Scoutmaster XL	135

SPOTTING SCOPES

Fieldscope (60mm)			347.95
Fieldscope 60 ED II	574.95	60 ED II Angled	634.95
Fieldscope 78 ED	1229.99	78 ED Angled	1299.99

Leica

SPOTTING SCOPES
APO TELEVID 77mm
Ask About Leica's Passport Protection

Kowa

77MM SERIES SPOTTING SCOPES

TSN-2	379.95	TSN-3	799.95

TSN-4 . . . . . $649.95

82MM SERIES WATERPROOF SPOTTING SCOPES

TSN-821 Angled	CALL
TSN-822 Straight	364.95
TSN-823 Angled	814.95
TSN-824 Straight	CALL

Check Out Our Special Package Pricing on 820 Series Spotting scopes
Package includes: Scope, 20-60x, Case & Tripod.

ZEISS

Special! 15x60	$1,849
20x60 Image Stabilizer	CALL
Spotting Scopes	CALL

Canon

IMAGE STABILIZERS
10x30 • 12x36 • 15x45
15x50 AW • 18x50 AW
$50 Rebate!

FUJINON

SPECIAL! 7x50 FMTRC-SX w/Compass			499.95
8x30 FMT-RSX	CALL	10x70 FMT-SX w/Case	CALL
7x50 FMT-SX w/Case	CALL	16x70 FMT-SX w/Case	CALL
Super 80 Scopes w/Zoom & Case			CALL

C90 Multicoated Spotter Outfit

With Free T-Mount!

$299.95

#81013

CELESTRON

BAUSCH & LOMB BUSHNELL

SPOTTING SCOPES

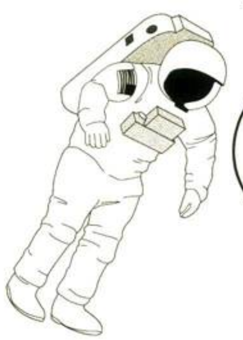
Discoverer 15-60x			176.95
Discoverer T-Mount	11.95	Camera Adapter	13.95
Spacemaster	149.95	Kit	247.95
Spacemaster Armored	163.95	Kit	259.95
Spacemaster Zoom Black Armored			226.95

All Kits Include: 15-45x Eyepiece & Case or Pouch

SWAROVSKI OPTIK

SPOTTING SCOPES
AT-80 • ST-80
AT-80 HD Angled
ST-80 HD Straight

Focus Camera, Inc., 4419-21 13th Ave., Brooklyn, NY 11219 ALL ORDERS ARE SUBJECT TO AVAILABILITY AND VERIFICATION. ORDERS ONLY CALL 888-221-0828 • INFORMATION & NY STATE CALL (718)437-8810 **Orders** ORDER STATUS & CUSTOMER SERVICE (718) 437-8899 • 24-HOUR FAX LINE (877) 863-6288 • STORE INQUIRIES (718) 436-6262. Shipped Promptly - Most Major Credit cards, Money orders & personal checks accepted for payment. COD orders are accepted but may require a deposit, personal checks may require up to 14 days to clear. All orders are subject to verification & acceptance. Shipping, handling & insurance are additional,please call/write for exact details. 14-day money-back guarantee (less shipping) provided merchandise is returned in new condition,



America's Largest Stocking Authorized Astronomy Dealer!

We Ship Promptly!

888-221-0828

N.Y. STATE & OVERSEAS
718-437-8810
E-MAIL ADDRESS
orders@focuscamera.com
Order on The Web at:
www.focuscamera.com

CELESTRON

SCHMIDT-CASSEGRAINS

NEW! NexStar 8

There is no substitute for size. With Celestron's legendary 8" optics, now you can see deeper into space with the same ease as with the innovative NexStar 5. Images in the NexStar 8 are over two times brighter than with a 5" telescope.

With the touch of a button, the NexStar 8 will open door to planets, galaxies and nebulae that you have never experienced in your lifetime. Exquisite design, pinpoint computer control and stability come together in one dynamic package.

NexStar 8 8", 2032mm f/10 ***NEW!***	$1,899
NexStar 5 5", 1250mm f/10 ***NEW!***	$1,199
NexStar Tripod	$175
G-3 3.5", 1000mm f/11	$499
G-5 5", 1250mm f/10	$699
G-8 8", 2032mm f/10	$999
G 9 1/4 9 1/4", 2350mm f/10	$1,299
CM-1100 11", 2800mm f/10	$3,199

SCHMIDT-CASSEGRAINS

CELESTAR 8 COMPUTERIZED

Engineered for unsurpassed optical performance in an affordable, full featured Schmidt-Cassergrain telescope of large enough aperture to do serious deep-sky observing. This telescope is carefully crafted and manufactured in the USA for dependable quality of the highest caliber. It offers the lowest price ever for a Celestron fork mounted 8" telescope.

CELESTAR 8 8", 2032mm f/10	$1,099
CELESTAR 8 Computerized	$1,599
CELESTAR 8 Deluxe	$1,699
CELESTAR 8 DLX Computerized.	$2,199
ULTIMA 2000 8" 2032mm f/10 2032mm f/10 w/Go To System	$2,699
CM-1400 14", 3910mm f/11	$5,299

REFRACTORS

Firstscope 80 Series
80mm (3.1")
3 Models Avail.

Firstscope 60 Series
60mm (2.4")
4 Models Avail.

Firstscope 70 Series
70mm (2.8")
3 Models Avail.

Firstscope 60	$109
Firstscope 60 Equatorial	$159
Firstscope 80 Equatorial	$349

C80-HD 80mm (3.1"), 900mm f/11	$399
C102-AZ 102mm (4"), 1000mm f/10	$399
C102-HD 102mm (4"), 1000mm f/10	$499
CR-150-HD 150mm (6"), 1200mm f/8	NEW!

NEWTONIANS

Firstscope 76 Equatorial 76mm (3")	$159
Firstscope 114 Series 114mm (4.5") *4 Models Avail.*	
Firstscope 114 Dlx w/Wood Tripod	$299
Firstscope 114 Premium w/Alluminum Tripod	$349
C114-HD 114mm (4.5"), 900mm f/8	$399
C150-HD 150mm (6"), 1000mm f/7	$499

STAR HOPPER DOBSONIANS

4.5" . . . $239   6" . . . . $399   8" $499

EYEPIECES & VIEWING ACCESSORIES

Diagonal, Prism Star	39.95	Diagonal, Mirror 2"	129.95
Diagonal, Erect Image 45°			39.95
Diagonal, Erect Image 90°			49.95
Plossl 1.25" 32, 40mm	49.95	Tele-Extender Dlx	48.95
Plossl 1.25" 6.3, 7.5, 10, 12.5, 17, 20, 26mm			39.95
Ultima 1.25" 5, 7.5, 12.5, 18mm			74.95
Ultima 1.25" 24, 30, 42mm			94.95
Ultima 1.25" 35			99.95
LV Series 1.25" 5, 6, 9, 10, 15mm			94.95
LV Series 1.25" 2.5, 4, 12, 20, 25mm			109.95
LV Series 1.25" 8-24mm Zoom			159.95
BARLOWS			
2x 1.25"	39.95	2x .96"	19.95
2x 1.25 Ultima	62.95	2x .96" Dlx	44.95

FILTERS

4 Piece Filter Sets	49.95	Skylight Filter	44.95
Moon Filter 1.25"	16.95	Solar Filters	CALL
LPR Filter Model A 1.25"			59.95
LPR Filter Model B f/Back Threads of SC's			84.95
Polarizing Filter Set 1.25"			42.95

SPOTTING SCOPES

C5 Spotter

- Fully multicoated optics
- Excellent light gathering ability
- Standard 8x20 erect image finderscope
- Near focus of 20'
- 45° erect image diagonal & 26mm Plossl 48x eyepiece – both 1.25"
- 22mm eye relief and 1° field of view with standard eyepiece
- Fitted with convenient tripod adapter block

C5 Spotter	$599
80mm Wide View	$199
50mm Zoom	$99
60mm Zoom	$69
30mm Mini Spotter	$49

TRIPODS & MOUNTS

Heavy Duty Tripod (93499)	284.95
Photographic Tripod (93596)	99.95
Standard 8" Wedge (93656)	92.95
Heavy Duty Wedge (93655)	239.95
Upgrade Kit f/93655	109.95
Equatorial Mount CG-3	144.95
Equatorial Mount CG-5	369.95
CI-700 Mount	1,859.95
Vibration Supression Pads	39.95

ACCESSORIES

AC Adapter	18.95	Lens Shades	CALL
Focus Motor	114.95	Motor Drives	CALL
Car Battery Adapter	18.95	T-Adapter f/C90	28.50
Radial Guider	97.95	T-Adapter f/SCT's	24.95
Case f/C5 & C8 (Most Models)			209.95
Counterweight Bar Assembly 8"			89.95
Counterweight Bar Assembly 11"			94.95
DEC Motor f/C5+, Celestar 8, Ultima 9 1/4/11			CALL
Digital Setting Circles			299.95
Flashlight Red Astro Lite			9.95
Flashlight, Night Vision			21.95
Focus Micrometer, Digital			109.95
Hand Controller f/C5+, Celestar 8			49.95
Piggyback Mount 8"			34.95
Reducer/Corrector f/6.3			111.95

FINDERSCOPES

5x24	23.50	7x50 w/Illuminator	159.95
6x30	39.95	9x50	44.95

unused as received with papers & packaging intact. We gladly accept and reply to written or faxed inquiries. Ad prices available while supplies last. This ad supersedes all previous ads. Focus camera is not responsible for typographical errors. Hours: Mon.-Thurs. 9-7, Fri. 9-2, Sun. 10-6.

TeleVue
Visionary

Renaissance-101

101mm (4"), 540mm f/5.4
Available in Green or Ivory

IN STOCK!

TV-85

85mm, 600mm f/7
Available in Green or Ivory

IN STOCK!

Pronto™

70mm ED, 480mm f/6.8
Available in Ivory or Green

w/1.25" 45° Erect Prism (PGA/PIA)	$925
w/1.25" Star Diagonal (PGO/PIO)	$945
w/2" Star Diagonal (PGD/PID)	$1,085

Ranger

70mm ED, 480mm f/6.8
Available in Ivory, Green or Brass

w/1.25" 45° Erect Prism (RGA/RIA)	$685
w/1.25" Star Diagonal (RGO/RIO)	$695

Ranger Power Package
Includes: 90° Star Diagonal, 20-60x Zoom, 2.5x Powermate & Shoulder Bag (RPP2500) . $1,030

MOUNTS

TELE-POD MOUNT SYSTEM Complete 7lbs Mounting System Ideal for Traveling	$325
Ash Panoramic Mount	$455
Ash Gibraltar Mount	$530
Ash Gibraltar w/Sky Tour	$1,210
Up-Swing Head	$110

EYEPIECES

ZOOM EYEPICE 8mm-24mm $210

PLOSSL (50°)		**PANOPTIC (68°)**	
8, 11mm 1.25"	82	15mm 1.25"	210
15mm 1.25"	82	19mm 1.25"	240
20, 25mm 1.25"	95	22mm 2"/1.25"	280
32mm 1.25"	110	27mm 2"	330
40mm 1.25"	110	35mm 2"	365
55mm 2"	228	Barlow Interface	90
RADIAN (60°)		**NAGLER (82°)**	
3, 4mm 1.25"	228	4.8mm 1.25"	175
5, 6mm 1.25"	228	7mm 1.25"	220
8mm 1.25	228	9mm 2"/1.25"	240
10mm 1.25"	228	**NAGLER Type 2 (82°)**	
12mm 1.25"	228	16mm 2"/1.25"	310
14mm 1.25"	228	**NAGLER Type 4 (82°)**	
18mm 1.25"	228	12mm 2"/1.25"	340
NAGLER Type 5 (82°)		17mm 2"	370
31mm 2"	595	22mm 2"	445
BARLOWS			
2x 1.25"	105	2.5x Powermate	168
2x Big 2"	168	4x Powermate	265
3x 1.25"	105	5x Powermate	168

ACCESSORIES

RICH FIELD KIT Includes: 55mm Plossl, 2" Star Diagonal, SCT to 2" E.P. Adptr & 2" to 1.25" E.P. Adptr	410
RICH FIELD PREMIUM KIT w/Everbright 2" Star Diag.	480
Bino Vue Binocular Viewer	1,030
Paracorr Photo/Visual 2" Coma Corrector	235
NEW! *Everbright 2" Star Diagonal Mirror*	255
2" Enhanced Star Diagonal	190
1.25" Star Diagonal	75
1.25" Prism 45°	60
Air Chair	150
Basic Qwik Point (QPU)	19.95
Starbeam Projection Finder	180
Camera Adapter 1.25" & 2"	36
Piggy-Cam Camera Adapter	42

TELRAD

Finder Scope . . . $36.49

ASTRONOMY BOOKS

The Deep Sky: An Introduction

By Philip S. Harrington Here is the perfect reference for anyone, who owns a telescope or a pair of binoculars but doesn't know what to look for amid the constellations. It explains how to find double and multiple stars, variable stars, open and gobular clusters, nebulae, and galaxies — what you'll see when you do.Includes 36 full-page sky charts; equipment, books, and software suggestions; sketches of how deep-sky objects look through a small telescope; and more than 100 black & white photographs. 272 pages.

The Deep Sky: An Introduction			24.95
Backyard Astronomer's Guide			39.95
Nightwatch: A Practical Guide to Viewing the Universe, 3rd Edition			29.95
Star-Hopping for Backyard Astronomers			19.95
Celestron Sky Map			16.95
Meade Star Chart			16.95
Sky Altas 2000			
Deluxe Edition			49.95
Desk Edition	27.95	Field Edition	27.95
Laminated Deluxe Edition			99.95
Laminated Desk Edition			59.95
Laminated Field Edition			59.95

JMI
JIM'S MOBILE INC.

Next Generation Computers
Motofocus • NGF Focuser
Wheely Bars • Motodec

THOUSAND OAKS

Precision Glass Solar Filters
Mounted Type 2
Mounted Type 2 Plus
Mounted Type 3 Plus

ASTRONOMY SOFTWARE

RedShift 3	
CD f/Windows	$44.95
CD f/Macintosh	$44.95
The Sky	
Level IV, Ver. 5	
CD f/Windows	$239.95
Skymap Pro 6.0	
CD f/Windows	$89.95
SkyChart III CD	$38.95

Take advantage of our LARGE INVENTORY! Immediate shipment from stock!

Reflections on
REFRACTORS

Start kids off on a lifelong adventure in astronomy with a simple telescope.

by Glenn F. Chaple, Jr.

Kids are naturally curious about the universe. For some, their yearning to learn is strong enough to result in the purchase of a telescope. But before that happens, the adult in charge is faced with a raft of questions concerning which telescope design is better: refractors or reflectors. This month and next, Kids' Corner explains the basics of the two major types of scopes. So, if you're considering a telescope purchase for a child, this guide should refine your vision and help you make the best available choice.

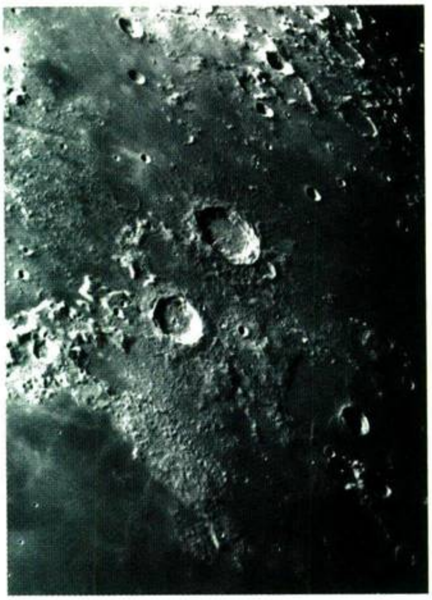
A small refractor gives young observers portability, sharp images, and all-purpose flexibility for viewing planets and deep-sky objects. *Astronomy*: Jim Forbes

Telescope Basics

Ask anyone what a telescope does, and the immediate response is that it makes distant objects look bigger and closer. That's true for landmarks on Earth and for many astronomical sights. But it's not the case with stars, which remain as single points of light. Stars do, however, demonstrate a telescope's second power — the ability to make things brighter. A telescope collects much more light than the human eye, making stars normally visible to the unaided eye shine even brighter than before. Thousands more magically come into view. Faint nebulae and galaxies also pop into sight.

And while the light-gathering capability of a telescope is equally as important as its magnifying power, a third power — called the resolving power — describes the sharpness of a telescope's image. A telescope with good resolving power brings out details. One with poor resolution shows the same image as a fuzzy outline.

You might think that telescopes are pretty complicated gadgets, but they're not. Actually, the typical backyard telescope is quite simple. A telescope consists of two major components: the optics that allow viewing of faraway objects, and the mount that holds the optics steady. The two basic types of scopes are refractors and reflectors. (A hybrid of these designs also exists, the compound, or catadioptric, telescope.)



Refractors crisply show lunar features such as craters Eudoxus and Aristoteles. Gérard Therin

Mounts come in two types, the altazimuth and the equatorial. The altazimuth, which has simple up-and-down (altitude) and side-to-side (azimuth) motions, is less expensive and easier to operate but won't follow the sweeping arcs made by the moon, planets, and stars as they drift across the sky. An adaptation of the altazimuth, called the Dobsonian mount, looks like an open box mounted on a lazy Susan. It provides the stability lacking in traditional alt-az mounts and is typically used for large reflecting telescopes. An equatorial mount matches the sky's motions and, if it comes with a motor called a clock drive, automatically keeps the scope on target.

TWO REFRACTORS IN ONE

Many people own telescopes without really realizing it — two of them, in fact. We're talking about binoculars. The standard binocular is made up of two identical small refractors mounted side-by-side. Binoculars are an essential tool for astronomers because many sky sights (like bright comets or Milky Way starfields) cover an area too large to be taken in by a standard telescope. The numbers on the barrel of a pair of binoculars (7x35, 7x50, 10x50, etc.) tell you the binocular's magnifying power (the first number) and the aperture, or diameter, of the objective lenses in millimeters (the number that follows the "x"). Our recommendation? The 7x50 or 10x50, because 50mm objectives collect two times more light than the more common 35mm objectives.

How Refractors Work

More people know how to tinker with automobiles or computers than with a telescope, which is far simpler in design. Take a look at a refractor and you'll see a long tube with glass lenses at both ends. The larger lens, which is aimed toward the object you want to view, is called the objective lens. A smaller, removable lens at the far end (where you peer in with your eye) is the eyepiece. Both objective and eyepiece

MAGNIFYING THE TRUTH

The importance of a telescope's magnifying power is grossly overrated. Galileo made his milestone observations with telescopes that never magnified more than 30x. This is comparable to the lowest magnification a present-day 60mm (2.4-inch) refractor offers. And the 60mm refractor, the most common one purchased by beginners, offers far better image quality or resolution than Galileo's telescope had.

What if you want to dig deeper than Galileo? How high can your telescope magnify? Well, certainly not the 200x, 300x, or 500x the manufacturers of many 60mm refractors promise. There is an upper limit to how much magnification a telescope will deliver. On most nights, our turbulent atmosphere (air motions that make stars "twinkle") limits a telescope's magnification to about 20x per inch of aperture (the diameter of the objective lens or mirror).

For a 60mm refractor, that's 2.4x20, or about 50x. On those rare evenings when our atmosphere is steady, we can max out at about 40x to 50x per inch of aperture (100x–120x). High power provides better detail of the moon and planets.

How do you calculate a telescope's magnifying power? It's a simple math problem. Somewhere on the tube of your main scope is a label that describes the aperture and focal length of the objective lens, expressed in millimeters. For the standard 60mm refractor, this reads "D = 60mm F = 700mm (sometimes 800 or 900mm)." It's the latter number, the focal length of the objective, that we want. Now look closely at the eyepiece. You'll see the eyepiece focal length in millimeters. This is the second piece of info we need.

To calculate the magnifying power, simply divide the telescope's focal length by the eyepiece focal length. Example: A refracting telescope with a 700mm focal length, coupled with a 20mm eyepiece, yields a magnifying power of 700 divided by 20, or 35x. Switch to a 6mm eyepiece, and the power jumps to 117x — about the maximum useful power for a 60mm refractor.

HOW REFRACTORS GOT STARTED

The refracting telescope has the distinction of being the first type of telescope invented. No one can say for certain when this happened or who invented it. Most sources point to the Dutch eyeglass maker Hans Lippershey, who fashioned a crude spyglass in the early 1600s. News of this marvelous optical tool reached the Italian scientist Galileo Galilei, who fashioned a telescope of his own in 1609. Galileo turned his telescope toward the sky and a new era in astronomy was born.

Galileo's telescopes never exceeded magnifications of 30x, yet he discovered the moon's craters, the changing phases of the planet Venus, and four of Jupiter's brightest moons. (We call these moons — Io, Ganymede, Callisto, and Europa — the Galilean satellites). Galileo also saw countless stars invisible to the unaided eye. Today's budding astronomers can repeat Galileo's exciting observations using the simplest telescopes.

are held in place by a long tube, blackened on the inside to cut glare. Most refractors also have a focusing knob near the eyepiece and a tiny telescope (the finderscope) mounted parallel to the main scope.

Light from a distant object strikes the objective lens first. This lens is convex (curved and thicker in the middle). A convex lens by itself tends to act like a prism, separating light into its component colors. For this reason, a higher-quality refractor telescope couples its objective lens with a thin correcting lens. Together, the two are called an achromatic objective. This lens bends, or refracts, the incoming light inward to form a small, upside-down image.

There's a neat way to show youngsters the image formed by the objective lens of a refracting telescope without dismantling your telescope. Use a magnifying lens, which is convex. Though not achromatic, it still produces a workable image. Indoors, on a day when it's bright outside, pull down all the window shades except one. Pull the last shade partially down, but not all the way. The room should be reasonably dark.

Tape a sheet of white paper on a wall facing the window. Position the magnifying lens a foot or two in front of the paper, between it and the window. Move the lens in and out until a sharp image appears on the paper. What you'll see is a tiny upside-down view of the scenery outside the window. It's like magic. The distance between the lens and the image, or image plane, is called the focal length. Focal lengths vary from one convex lens to another. Generally, the more the lens is curved, the more it bends light and the shorter the focal length. The paper lets you view the image (called a real image), but the image itself is suspended in space.

After the novelty wears off, most youngsters will want to know why it's upside down. You can simply tell them that light rays crisscross after passing through a convex lens. But what about the small size of the image; aren't telescopes supposed to magnify things? That's where the eyepiece comes in. The image projected onto a sheet of white paper could be enlarged with another magnifying lens.

TELESCOPE TERMS

ALTAZIMUTH: An inexpensive type of telescope mount that produces up-and-down and side-to-side motions.

APERTURE: The diameter of the objective lens or mirror of a refracting or reflecting telescope.

CATADIOPTRIC: A telescope design that combines the characteristics of both reflecting and refracting telescopes.

CLOCK DRIVE: An accessory found on some equatorial mounts that lets a telescope track sky objects as Earth rotates.

DOBSONIAN: A simple modification of the altazimuth mount.

EQUATORIAL: A type of telescope mount that allows the telescope to track sky objects with one sweeping motion.

EYEPIECE: The part of a telescope's optics that enlarges the image.

FINDERSCOPE: A miniature telescope mounted parallel to the main telescope tube that aids in locating sky objects.

FOCAL LENGTH: The distance between the objective lens or mirror and the image it forms.

OBJECTIVE: The light-gathering lens or mirror in a telescope that forms the image.

REFLECTOR: A type of telescope that uses a concave mirror to collect light and form an image.

REFRACTOR: A type of telescope that uses a convex lens to collect light and form an image.

A MINIATURE REFRACTOR

Try aiming your telescope while looking through the main optics and you're bound to have trouble. The circular chunk of sky a telescope captures is so small that you could waste many minutes combing the sky in search of that planet or galaxy. Here's where the finderscope comes in. The finderscope is a miniature, low-power refractor mounted atop the main scope. Typically magnifying just five or six times, it covers a large area of sky (5–6° — about 10–12 moon diameters). Center a planet in the crosshairs of a finderscope, and the telescope should be on target.

If it isn't, check to see that you've placed a low-power eyepiece in the main scope (low power makes finding sky objects easier), and that it's reasonably focused. Another problem may be that your finderscope is out of alignment. Center the finder on a distant landmark (or streetlight, if you're out at night). The moon, a bright planet, or a star also works, but its constant motion as Earth rotates complicates things. Once your landmark is centered in the finder, look for it in the main scope (remember, low power works best). Once found, center the landmark in the eyepiece field and tighten the mount's locking screws. Look back in the finderscope and adjust it (usually with setting screws) until the landmark is centered on the crosshairs. Now look back in the main scope, and the image should be visible there as well.

Remember, however, that the image is always present at a given distance (the focal length) from the objective. So if we then place our magnifier (the eyepiece) opposite the image from the objective and position our eye an inch or so behind it, we can move the eyepiece in and out until an enlarged image comes into view. The image is still upside down, but it's big.

Did You Know?

A standard 60mm (2.4-inch) refractor collects 100 times more light than the average human eye. But this is nothing when compared to the light-gathering power of the world's largest refractor, located at Yerkes Observatory in Williams Bay, Wisconsin. This giant telescope has an objective lens 40 inches in aperture — big enough to gather as much light as 30,000 eyes. The tube holding this huge lens is 63 feet long. That's the length of four minivans parked bumper to bumper.

So, in effect, we've made a simple telescope out of the room. The larger magnifying glass is like the objective lens at the front end of a refracting telescope. It collects the incoming light and forms a small, upside-down image. The eyepiece at the other end magnifies that image, just like the eyepiece of a telescope.

For some hands-on experience with a refracting telescope, without the risk of damaging an expensive model, try the refracting telescope kit offered by Project STAR, a division of Learning Technologies, Inc. It's a simple refractor with plastic lenses mounted in a cardboard tube. Sure, the optical quality isn't the best, but it works. When assembled, it's a 16x refractor capable of revealing lunar craters and Jupiter's moons. The best part is that no glue is needed. The scope can be assembled and disassembled over and over — a plus for classroom teachers.

For more information on the Project STAR telescopes, which can be bought in bulk, contact Learning Technologies, Inc., 40 Cameron Avenue, Somerville, MA 02144, telephone: (800) 537-8703; or you can check out their website at www.starlab.com/.

Glenn F. Chaple, Jr. is a teacher and longtime contributor to Astronomy.

Observing Like a Pro

The Advanced Observing Program at Kitt Peak offers visitors the chance to play the part of professional astronomer.

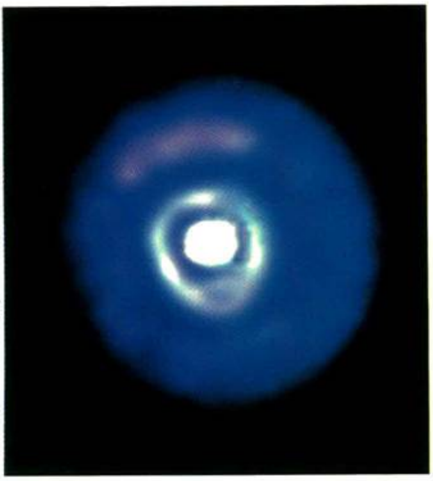
by Adam Block

THE LATE AFTERNOON SUN MAKES THE SILHOUETTES OF THE telescopes on Kitt Peak difficult to see against the bright blue western sky. Guests anticipate an exciting night as part of the evening public programs during the one and a half hour drive to the mountain from Tucson. Suspense builds as the telescopes disappear behind mountains in the foreground and reappear just a few miles from the base of Kitt Peak. The road gently curves and meanders toward the top passing cacti and cottonwood on its way. The summit of the mountain offers its welcome with the white and silver domes of this astronomical facility.

More than 300 people from around the globe have made this journey to participate in the Advanced Observing Program. The all-night sessions began in the spring of 1997 (see "Stargazing at Kitt Peak," July 1997). The capabilities and resources of the Visitor Center Observatory have improved dramatically since then.

M57 (Ring Nebula) by Bethany and Amanda VanStavern

NGC 2359 by Carina and Shawn Patten



NGC 2392 (Eskimo Nebula) by Mike Stegina and Kyle McNatt

After a quick greeting guests are shown to their dorm room where they can relax. Otherwise they can visit the mountain's public areas that are still open. The room is shared accommodations with its own heater, bathroom, and shower. Dinner is served in the kitchen with the observatory's employees where guests can listen to the telescope operators talk about dewars and drives while astronomers discuss everything from brown dwarfs to black holes. Finally the last light from the sun disappears behind the mountains on the horizon and stars appear. Gentle creaks and groans of metal echo faintly in the distance as observatories open to the heavens above.

Kitt Peak by Adam Block

M1 (Crab Nebula) by George and Betsy Crossley

M63 (Sunflower Galaxy) by Andy Fisher

M5 by Neal Allen

The early evening presentation is full of activity at the Visitor Center. Star charts, binoculars, computer simulations, and the 16-inch telescope offer the public perspectives in astronomy for the next three hours. At its conclusion, the group of 20 visitors departs the mountain. The observatory and its resources are now open to Advanced Observing Program participants until sunrise. In their new role as visiting astronomers, they are supported throughout the night by an experienced guide/telescope operator. Activities include CCD imaging, astrophotography, and even visual observations. No previous experience is required to enjoy an all-night observing session. The only prerequisite for the program is an enthusiastic appreciation of the universe.

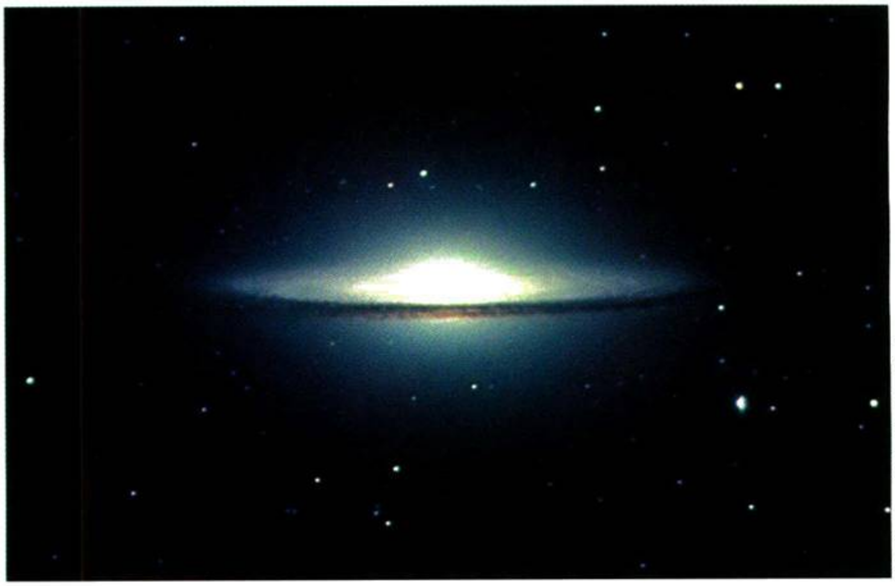
Most guests who reserve a night at the Visitor Center Observatory are amateur astronomers who enjoy the hobby differently. When this program began we feared our visitors would be very advanced amateurs with special and difficult projects. However, this has not been the case. In fact it is difficult to generalize about past participants in any meaningful way because their backgrounds, ages, vocations, and experiences vary dramatically.

For example, pilots and radiologists who have participated in the all-night program seem to appreciate astronomy in different ways. The high-flying souls of 30,000 feet want to capture and understand the beauty they see out their cockpit windows, while others with medical backgrounds get a kick out of the images and processing — reminiscent of x-ray and ultrasound pictures.

Fast Facts:

Website:
www.noao.edu/outreach/aop

Rates (per night):
$250 for observing at the Kitt Peak Visitor Center Observatory. $55 for each person who participates — limit of 2. (Total cost for one person — $305, for two people — $360. Guests may come alone or bring a family member or friend and will not be paired with strangers.)



M104 (Sombrero Galaxy) by Adam Block

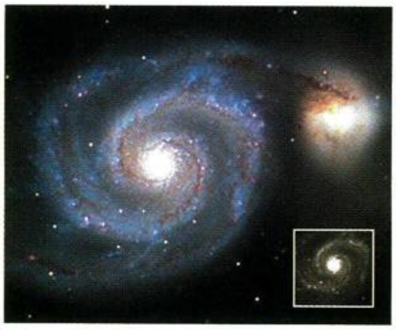
NGC 7635 (Bubble Nebula) by Mike Stegina Sr and Mike Stegina Jr

Getting Better with Age

CCD imagery has become the program's forte. Take, for example, the image of M51 published in *Astronomy* in 1997 (below, inset) and compare with a recent image (below right). We have truly come a long way! More than 80 percent of the participants leave the mountain with CCD images, and it is in the area of CCD imaging that the Advanced Observing Program has made its greatest strides.

There are three main reasons for the improved image quality. First, the addition of an SBIG ST8E CCD camera and new color filter are perhaps the most obvious improvements. The sensitivity of the new chip along with its size permits pictures of both large and faint objects. However, the second improvement, the minimization of guiding errors, is certainly more important than the camera. Indeed, the extra sensitivity makes the tolerance in guide errors extremely conservative. Currently the Meade 16-inch LX200 can be made to guide with errors averaging less than 1.5 pixels at f/6.3 (0.8 arcsecond/pixel). Consequently, images are now taken using the full resolution of the ST8. With future adjustments, we hope to make net guiding errors even smaller.

New software and processing techniques can take the intrinsically "good" (well-guided) data from the new camera and yield pictures unmatched in amateur astronomy — and perhaps even the professional world. Software such as TheSky and Tpoint by Software Bisque allows a telescope operator to spend more time exposing and less time trying to find targets and guide stars. CCDSharp by SBIG provides an excellent way to polish up images and bring out detail. MaximDL, by Cyanogen Productions, is a fantastic program for both camera control and image processing. Tasks such as image calibration, registration, and LRGB color production are so easy that guests are guaranteed completed color images before they leave the mountain. When all is said and done the improvements typically produce hundreds of megabytes of data that are copied to a CD-ROM for the guest at the end of the night.



M51 images (Whirlpool Galaxy) by Adam Block

Guests between 14 and 21 years old may have just discovered the thrill of space and science. To these guests, merely choosing the targets to observe is an empowering experience. Some have discovered a random asteroid slowly moving through the field. Participants have detected more than 12 unknown asteroids recently — a few discoveries have even been given designations. And finally, older guests take advantage of the program as either a retirement trip or completion of a lifelong dream.

All this could not take place without the continued support of participants and astronomical vendors who contribute through donations. Equipment such as computers, focal reducers, AO-7 accessories, enhanced CCD chips and JMI focuser units were acquired through donation. Donations also produced all the software in the Visitor Center Observatory Library.

The images shown on these pages reveal the beauty of the universe and demonstrate the exciting journey guests take through their participation in these all-night sessions. More importantly, the images show that now the most difficult part of the Advanced Observing Program is no longer trying to acquire a pretty picture — but rather trying to stay awake till dawn.

Adam Block is the lead observer for the Nightly and Advanced Observing Program at Kitt Peak, the National Optical Astronomy Observatory (NOAO). NOAO is operated by the Association of Universities for Research in Astronomy (AURA), Inc. under cooperative agreement with the National Science Foundation.

NGC 6772 by Bonnie, Jim, Bryan, and Kelly Mangold

NGC 5426/7 by Carol Swigart and Thane Kirchhoff

Telescopium, Indus and Pavo

Astronomy: Kellie Jaeger

Galaxies galore populate this trio of southern constellations.

by Tom Polakis

AS THE COOLER AIR OF AUTUMN descends across the Northern Hemisphere, the splendors of the summer sky sink in the west. Sagittarius and the center of the Milky Way dip below the horizon by midevening, yielding to a rather sparse region where star patterns are difficult to trace and galaxies prevail. The southernmost of the constellations east of the Milky Way rank among the most obscure in the entire heavens. From the northern United States, only the top stars in Telescopium and Indus poke above the southern horizon, while Pavo remains completely hidden. Most of this area comes into view from the southern tier of states, though the vista improves markedly from locales even farther south.

A small triangle of modest stars south of Corona Australis forms the shape of Telescopium the Telescope. Only Alpha (α) Telescopii, a yellowish star located 750 light-years from Earth, shines brighter than magnitude 4.0.

To the telescope's south lies Pavo the Peacock. With 10 stars shining at 4th magnitude or better, the peacock appears reasonably bright even though the pattern remains hard to trace. At magnitude 1.9, Alpha Pavonis, the Peacock star that represents the bird's eye, easily dominates this part of the sky. This hot, blue-white star glows with the light of 400 suns from a distance of nearly 200 light-years. Spectroscopic observations show that Peacock has an unseen companion that revolves around it every 12 days.

Indus the Indian covers a broad expanse of sky to the east of both Telescopium and Pavo, though anyone would be hard-pressed to make out a human form from this smattering of relatively faint stars. Its brightest sun, 3rd-magnitude Alpha Indi, glows with a yellow-orange color.

Our tour of this trio of southern constellations begins in far western Pavo. Point your telescope at 4th-magnitude Eta (η) Pavonis and you'll find the irregular galaxy **IC 4662** in the same field, just 10' to the star's northeast. A large stellar association that contains two emission nebulae dominates the appearance of this dwarf galaxy. In the eyepiece, this large association shows as an enhancement of an otherwise featureless, small haze. Well-baffled optics will help you view the galaxy by minimizing the glare from our guide star.

Another stellar contaminant lies 6° east of Eta. Sixth-magnitude Theta (θ) Pavonis sits just 10' north of **NGC 6684**, a barred spiral galaxy 40 million light-years away. It proves an easy find in an 8-inch telescope, which shows a very bright core surrounding a circular halo 2' across. Increasing the aperture brightens the galaxy but fails to reveal additional detail.

Pan another 3° to the east-northeast and you'll come to the grand spiral galaxy **NGC 6744**. With a magnitude of 8.6, you might think this would be a spectacular galaxy with plenty of spiral detail. Unfortunately, that's not the case. The situation reminds me of M101 in Ursa Major. Because the light from NGC 6744 spreads out over such a large area (16' by 10'), the spiral arms don't come into view until apertures exceed 10 inches. In a 13-inch telescope, expect to see a bright oval measuring 5' by 3' with an even brighter core. The outer reaches of the halo appear clumpy, which suggests spiral structure, but the arms are by no means easy to see and quite different visually from what photographs would suggest. Astronomers have detected several young, massive star clusters in NGC 6744 that could be recently formed globular clusters. If so, these clusters would be unlike any found in our galaxy, where all the globulars appear ancient.

Just 4° north of this galaxy lies the showpiece of the entire region. One of the sky's brightest globular clusters, **NGC 6752** can be seen easily with the naked eye from a dark site. A 6-inch telescope resolves hundreds of stars from the outer reaches down to a strongly concentrated core. Two prominent star chains radiate to the east and a loop-shaped chain appears on the northern edge. An 8th-magnitude star lies near the southeastern edge of the densest part of the cluster. NGC 6752 looks big and bright because it's relatively nearby, only 13,000 light-years from Earth.

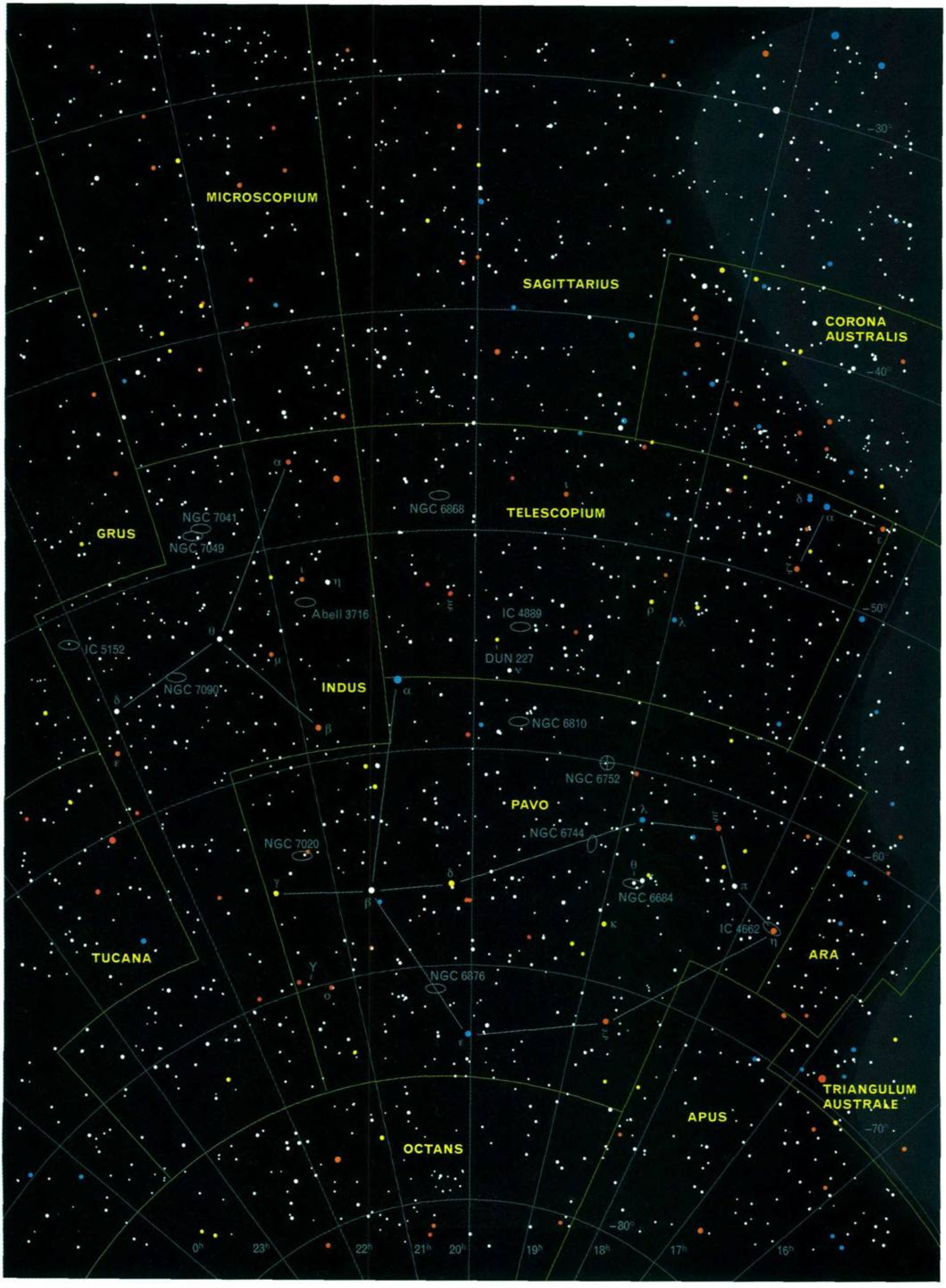
A nearly edge-on spiral galaxy sits approximately 5° east-northeast of the globular. At a distance of 100 million light-years, **NGC 6810** shows up in a large telescope as a haze stretching only 2' by 1' and elongated north-south. Its much brighter core measures about 30" across.

The elliptical galaxy **IC 4889** lies 5° north of NGC 6810 and appears similarly bright. A 10-inch telescope shows a slightly oval galaxy about 1.5' long. Its bright, broadly concentrated core fades gradually into a dim, circular haze when viewed through the largest backyard scopes. A much smaller and fainter companion galaxy, IC 4888, lies 8' to its south.

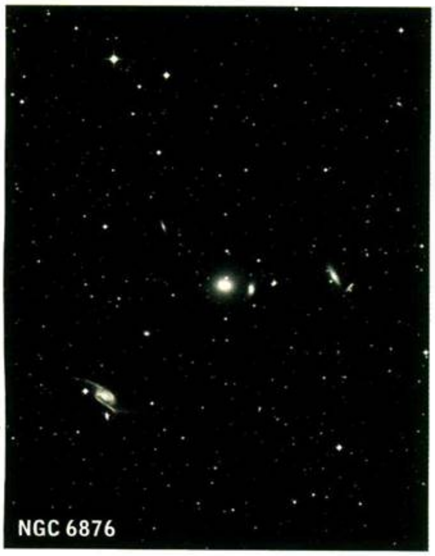
Now it's time to take a quick break from all these galaxies. Nudge your telescope 1° to the southeast of IC 4889 and you'll come to the wide double star **Dunlop 227**. A low magnification of 50x or so shows the pair at its most striking. A yellow star of magnitude 5.7 complements a slightly fainter,

NGC 6752

Luke Dodd


MICROSCOPIUM
SAGITTARIUS
CORONA AUSTRALIS
-30°
-40°
TELESCOPIUM
NGC 6868
ι
α
GRUS
NGC 7041
NGC 7049
η
ι
Abell 3716
IC 5152
θ
μ
NGC 7090
δ
INDUS
α
IC 4889
DUN 227
ν
NGC 6810
β
ε
-50°
δ
α
ε
ζ
ρ
λ
NGC 6752
PAVO
NGC 6744
λ
ξ
NGC 7020
γ
δ
β
θ
NGC 6684
π
-60°
κ
IC 4662
η
ARA
TUCANA
γ
ο
NGC 6876
ε
ζ
TRIANGULUM AUSTRALE
APUS
-70°
OCTANS
-80°
0h
23h
22h
21h
20h
19h
18h
17h
16h

Astronomy: Elisabeth Rowan



NGC 6876

Copyright 1993-98 by AAO and AURA

NGC 6744

Andrew Peters

blue-white companion a generous 23" to the southeast. The two stars lie roughly 350 light-years away, well in the foreground of the distant galaxy cluster cataloged as Abell 3651.

Sweep 8° north of this double to find **NGC 6868**, a distant elliptical galaxy that ranks as the most prominent member of a small cluster containing 10 other galaxies. In a 13-inch scope, the bright galaxy appears 2' by 1.5' and elongated east to west. It has a very bright center that abruptly fades into a dim halo. Just 6' to the north lies NGC 6870, an elongated spiral galaxy that glows almost two magnitudes fainter. Several other fainter galaxies reside within a 15' radius, and another member of this cluster, NGC 6861, lies half a degree to the west.

Returning to the southern reaches of Pavo, we find the bright galaxy **NGC 6876** 2.5° northeast of the 4th-magnitude star Epsilon (ε) Pavonis. Classified as a cD (central dominant) galaxy, this massive elliptical lies at the center of a rich galaxy cluster. A 10-inch telescope shows the evidence, bringing several fainter companions into view. NGC 6876 appears as a bright circular smudge with a fairly broad, concentrated core. Two 12th-magnitude companions, NGC 6877 and NGC 6880, lie 2' and 6' to the east, respectively. And 9' northwest brings you to NGC 6872, a barred spiral galaxy that reveals only a faint core in all but the largest backyard telescopes.

Our next target lies 1° to the east-northeast of 5th-magnitude Omicron (ο) Pavonis. The fiery red star **Y Pavonis** is a fine example of a carbon star. Such stars are cool red giants with a high abundance of carbon in their outer atmospheres. Y Pav appears deep orange with almost any optical aid. As with many other red giants, its brightness varies slightly, between magnitude 6.1 and 6.7.

Panning 2° northwest of Gamma (γ) Pavonis brings you to **NGC 7020**, a ringed spiral galaxy whose disk inclines 20° from edge-on. Although ringed galaxies are fairly common, they almost always appear in barred spirals. Yet NGC 7020 shows no evidence of a bar. Seen across 150 million light-years, the galaxy does not look impressive. Its lens-shaped form measures 1' long and half as wide and sports a bright stellar nucleus.

Deep-Sky Objects in Telescopium, Indus, and Pavo

Object	R. A. (2000.0)	Dec.	Mag.	Size/Sep	Type	Notes
IC 4662	17h47.1m	–64°38'	11.3	3.7' by 2.5'	Gal	IAm
NGC 6684	18h49.0m	–65°11'	10.4	4.5' by 3.3'	Gal	SB(r)0
NGC 6744	19h09.8m	–63°51'	8.6	15.5' by 10.0'	Gal	SAB(r)c
NGC 6752	19h10.9m	–59°59'	5.5	20.4'	GC	
NGC 6810	19h43.6m	–58°40'	11.4	3.8' by 1.2'	Gal	SA(s)ab
IC 4889	19h45.3m	–54°20'	11.3	2.6' by 1.8'	Gal	SA(s)0
Dunlop 227	19h52.6m	–54°58'	6.1, 6.8	22.9"	Dbl	
NGC 6868	20h09.9m	–48°23'	10.6	4.0' by 3.3'	Gal	SA(rs)0
NGC 6876	20h18.3m	–70°52'	10.8	3.7' by 3.4'	Gal	E3
Abell 3716	20h51.5m	–52°42'	—	52'	Gals	66 galaxies
NGC 7020	21h11.4m	–64°03'	11.8	3.8' by 1.7'	Gal	(R)SA(r)0
NGC 7041	21h16.5m	–48°22'	11.2	3.3' by 1.4'	Gal	SA(rs)0
NGC 7049	21h19.0m	–48°34'	10.3	4.3' by 3.2'	Gal	SA(s)0
Theta Indi	21h19.9m	–53°27'	4.5, 7.0	6.3"	Dbl	
NGC 7090	21h36.5m	–54°33'	10.7	8.1' by 1.4'	Gal	Scd
Y Pavonis	21h24.3m	–69°44'	6.1–6.7		Var	Carbon star
IC 5152	22h02.9m	–51°17'	10.6	4.9' by 3.0'	Gal	IAB(s)m

Object: Designation in Messier, NGC, or other catalog. **R. A. (2000.0) and Dec.:** Right ascension and declination in epoch 2000.0 coordinates. **Mag.:** Visual magnitude. **Size/Sep:** Size in arcminutes; separation in arcseconds. **Notes:** Hubble type for galaxies.

The Peacock

> *"The splendor of the emerald*
> *shines in your neck*
> *And you unfold a tail*
> *Gorgeous with painted plumage."*
> Aesop's Fables

Nearly all the constellations buried deep in the southern sky have a relatively modern history. Invisible to the ancient Greeks, Romans, and other northern cultures, these star patterns had to wait for their stories to be told.

That's why so many southern constellations depict scientific instruments and not mythological beasts. Telescopium the Telescope was introduced by French astronomer Nicolas Louis de Lacaille in the 1750s while he was mapping the sky from the Cape of Good Hope. Along with Microscopium the Microscope, Horologium the Clock, and a host of others, these constellations paid homage to the great instruments of the day.

Yet not all of the southern sky met the same fate. Dutch navigators Pieter Dirkszoon Keyser and Frederick de Houtman introduced a dozen new constellations while mapping the southern sky at the close of the 16th century, including both Indus the Indian and Pavo the Peacock.

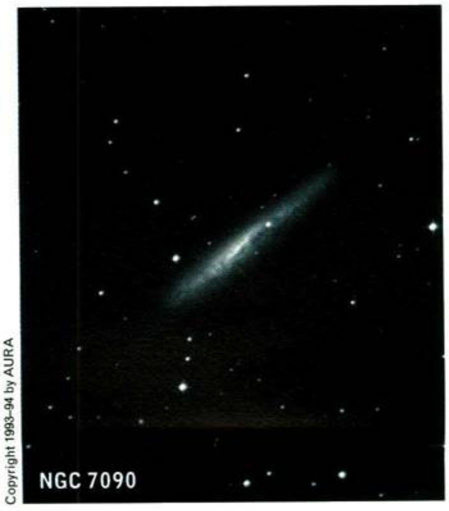
Peacocks, of course, have been around forever — and found their way into Greek myths. Perhaps the best known concerns Hera, the sister and wife of Zeus, who held peacocks to be sacred. One day Hera nearly caught Zeus fooling around with Io, and the chief god decided to disguise his illicit lover by turning her into a white cow. Ever suspicious, Hera had Argus watch over the cow, a task he was particularly well suited for because he had 100 eyes and rested only two at a time. Zeus sent his son Hermes to free Io, which he did by lulling Argus and all of his eyes to sleep and then severing his head. In tribute to Argus, Hera placed the eyes on the tail of the peacock, where they remain today. — *Richard Talcott*

The next object requires all the observing pieces to fall into place: dark skies, a large telescope, and plenty of patience at the eyepiece. The distant galaxy cluster **Abell 3716** contains more than 60 members in an area located 1° south of 5th-magnitude Iota (ι) Indi. The brightest of these glows dimly at magnitude 13.6 and measures just 1' across, but a large telescope should show more than a dozen galaxies in a 1° field. Telescopically, look for objects that appear barely nonstellar. As you gaze upon these galaxies, remember that they're actually every bit as large as the others on our observing list. Their diminutive size and subdued brightness come courtesy of the nearly 1 billion light-years of space their light must traverse.

A much more modest group of galaxies lurks in northeastern Indus. Two of the six group members can be seen easily in a backyard scope. The bright disk galaxy **NGC 7041** measures 3' by 1' and displays a bright, stellar nucleus. **NGC 7049** lies in the same low-power field, about half a degree to the southeast. It appears as a bright, circular haze some 2' across with a brighter center. Careful observers may notice a fainter galaxy between these two. ESO 235–85 belongs to the same galaxy group at a distance of roughly 100 million light-years.

Returning briefly to our own galaxy, check out the double star **Theta Indi** near the heart of the constellation. Both of the component stars glow white, with the primary at magnitude 4.5 and the secondary coming in at magnitude 7.0. Despite being separated by a relatively comfortable 6", the 2.5-magnitude difference means you'll need at least 200x to split the components cleanly.

Midway between Theta and Delta Indi lies the fine spindle of **NGC 7090**. At a distance of just 20 million light-years, this spiral galaxy extends a full 6' in a medium-sized scope. The spiral's disk inclines just 5° to our line of sight and measures less than 1' wide. A 12-inch mirror reveals a broadly concentrated center, but it takes significantly more aperture to bring out the subtle mottling in the spiral arms along the length of the spindle.



NGC 7090

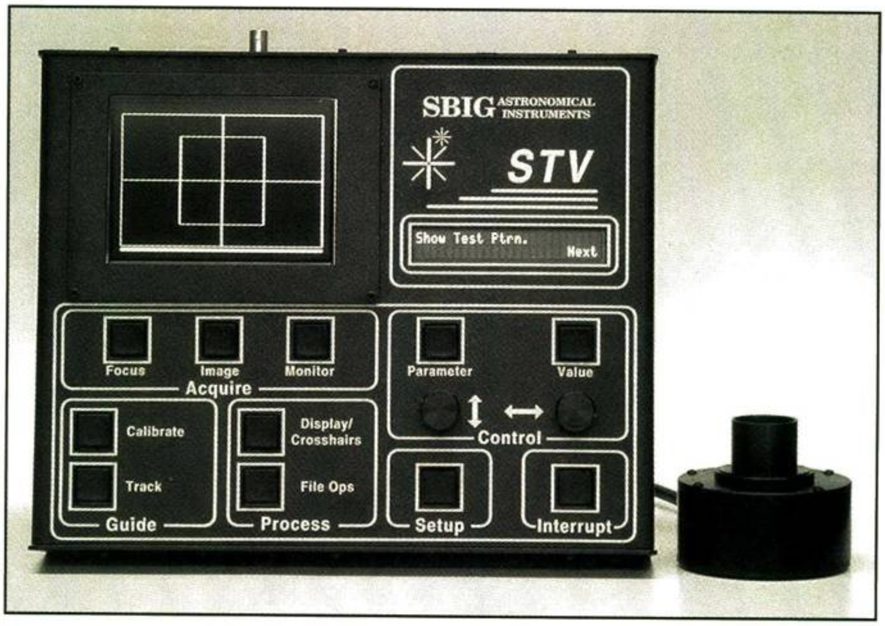
Copyright 1993–94 by AURA

Our tour concludes with the nearest galaxy in this part of the sky. The dwarf irregular galaxy **IC 5152** sits in far eastern Indus, next to its border with Grus. It lies a bit more than 5 million light-years from Earth, placing it just beyond the realm of the Local Group. In fact, it's closer to NGC 300 in the Sculptor Group than to the main Local Group spirals. Belonging to neither group, it remains one of the most isolated dwarf galaxies known. An 8th-magnitude foreground star interferes somewhat with the view. Still, a telescope as small as a 6 inch shows a mottled texture resulting from clumps of its brightest stars, which glow at 17th magnitude. In a 13-inch scope, IC 5152 appears 4' by 2' and very grainy, with a slightly brighter center. Larger telescopes leave open the enticing possibility of resolving individual stars in another galaxy.

Tom Polakis is an aerospace engineer who lives in Tempe, Arizona. His favorite astronomical pursuits are deep-sky observing and photography.

SBIG
ASTRONOMICAL
INSTRUMENTS

ANNOUNCES THE REVOLUTIONARY
STV


SBIG ASTRONOMICAL INSTRUMENTS
STV
Show Test Ptrn.
Next
Focus
Image
Monitor
Acquire
Parameter
Value
Control
Calibrate
Track
Guide
Display/ Crosshairs
File Ops
Process
Setup
Interrupt

The First STAND ALONE DIGITAL INTEGRATING *VIDEO* CAMERA AND AUTOGUIDER

LIKE NO OTHER ASTRO CAMERA OR AUTOGUIDER IN THE WORLD

- EASY TO USE, PORTABLE - **NO COMPUTER REQUIRED**
- VIEW THE MOON, PLANETS **AND** DEEP SPACE OBJECTS ON ANY VIDEO MONITOR OR ON THE OPTIONAL BUILT-IN 5″ LCD DISPLAY
- RECORD VIDEO IMAGES ON ANY VCR
- NO FRAME GRABBER REQUIRED
- STORE DIGITAL IMAGES IN THE STV's INTERNAL MEMORY FOR DIRECT DOWNLOAD TO A COMPUTER AT A LATER TIME
- OPERATES AS A STAND ALONE AUTOGUIDER, 30 TIMES AS SENSITIVE AS A ST-4
- REACH 14th MAGNITUDE IN ONE SECOND (18th MAGNITUDE IN ONE MINUTE) THROUGH AN 8″ SCOPE

SBIG
ASTRONOMICAL
INSTRUMENTS

SANTA BARBARA INSTRUMENT GROUP
147-A Castilian Drive
Santa Barbara, CA 93117
Phone (805) 571-7244 FAX (805) 571-1147
e-mail: sbig@sbig.com Home address: www.sbig.com

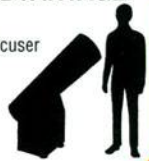
ODYSSEY®
TELESCOPES
Seeing the *real* Universe

PRESS RELEASE:

MURNAGHAN Instruments Buys Coulter Optical Assets. Production of **Odyssey® Telescopes** will continue. New product benefits from financial stability and management of MURNAGHAN Instruments Corporation.

THE ODYSSEY™ ADVANTAGE

- No assembly required
- Improved Dob mount and Focuser
- Double-strength Sonotube
- Eyepiece included
- Many options available
- Lowest prices anywhere



8-INCH f/4.5 $399.95

- Deep-space scope
- Tube 36 x 10.5 inches
- Diffraction-limited optics
- Includes wide-field eyepiece
- Reengineered mount system

8-INCH f/7 $399.95

- Lunar/planetary scope
- Tube 56 x 10.5 inches
- Diffraction-limited optics
- Includes high-magnification eyepiece
- Extra-stable mount

10-INCH f/4.5 $549.95

- Extremely portable
- Tube 45 x 12.7 inches
- Diffraction-limited optics
- Includes wide-field eyepiece
- Improved mount system

13.1-INCH f/4.5 $899.95*

- A BIG scope for less money
- Easy 1-person setup
- Tube 57 x 15.7 inches
- Diffraction-limited optics
- Includes wide-field eyepiece

* *For orders placed after 8-1-99*

HOW TO ORDER

Send no money. A deposit is **NEVER** required to process your order. Pay just before shipment by check, money order, Visa, or MasterCard.

For orders or information: Call 1-561-795-2201
Web: www.murni.com
Fax: 1-561-795-9889

VISA MasterCard

The New
Coulter Optical®
Div. MURNAGHAN Instruments
1781 Primrose Ln.
West Palm Beach, FL 33414
Bigger Scopes . . . Better Optics . . . *Less Money*

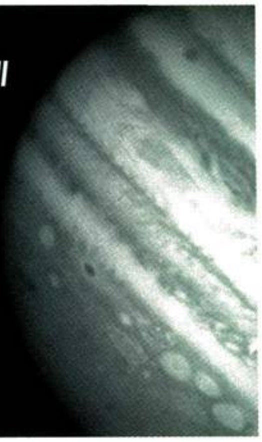
F. C. Meichsner Co., Inc.

Our 81 years of experience and knowledge will help you get the best optics for your money!

☆ Celestron ☆ Miyauchi ☆ Used Equipment
☆ Meade ☆ Fujinon ☆ Repair Service
☆ Tele Vue ☆ Nikon ☆ Large Showroom
☆ Takahashi ☆ Swift ☆ Worldwide Shipping
☆ Questar ☆ Bushnell ☆ Free Price List

☆ Accessories Always in Stock • Call for Monthy Specials

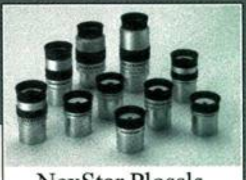
***Call us at:* (800) 321-VIEW! (8439)**
Fax: 617-426-0837 (24 hours)
E-Mail: Meichs@aol.com
***Visit us at:* 182 Lincoln Street, Boston, MA 02111**
Web site: http://www.meichsner.com



the right stuff

at the right place

for the right price



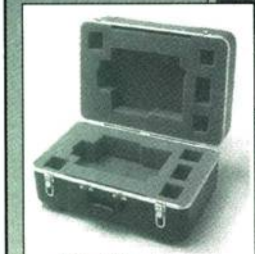
NexStar Plossls

NEW Celestron NexStar 8!

NIGHTWATCH

Books
Sky Charts
Software
Astronomical
Binoculars

Dew Shields



NexStar Cases

Complete GOTO Telescope with 18,000+ object database. Includes 81X Plossl eyepiece, AC Adapter, Star Diagonal, Star Pointer finder and Adjustable Aluminum Tripod.
All for only $1899.00!

Telescopes * Binoculars * Eyepieces * Filters * Tripods/Mounts
Dec/Focus Motors * Sky Maps/Books * Star Pointers/Finders
Complete Selection of Telescope Accessories

EAGLE OPTICS
(800) 289-1132
www.eagleoptics.com
2120 W. Greenview Dr. #4 Middleton, WI 53562

EAGLE OPTICS ©

2 GREAT LOCATIONS

Penna.-POCONO MOUNTAIN OPTICS

ORDERS: 800-569-4323
INFO: 570-842-1500

Las Vegas-POCONO WEST OPTICS

ORDERS: 800-635-3607
INFO: 702-252-7200

POCONO GLADLY ACCEPTS: *with no surcharge* DISCOVER NOVUS, VISA, MasterCard, AMERICAN EXPRESS

$7.00 MINIMUM SHIPPING/ UPS (in U.S.)

- Purchase Orders from Qualified Institutions Gladly Accepted
- We Purchase and Take In Trade Used Telescopes

Visit Our Two Showrooms in Moscow, PA and Las Vegas NV!

We carry the following lines & products for all of your astronomical needs: See online or printed catalog for full details:

ACCESSORY CASES
ADIRONDACK VIDEO
APOGEE
APOGEE INSTRUMENTS
ASTROMETRICS-GO TO SYSTEMS
ASTRO SYSTEMS
12-VOLT BATTERIES
BRANDON
BUSHNELL
CELESTRON
COLLINS ELECTRO OPTICS
CORONADO H-ALPHA SYSTEMS
DESERT STORM COVERS
FUJINON BINOCULARS
HOMEYER FLIP MIRRORS
JMI
KENDRICK
LASER MAX
LOSMANDY
LOMO
LUMICON
MEADE
OPTEC
PARALLAX
PENTAX
QUESTAR
RIGEL SYSTEMS
SBIG
SOFTWARE BISQUE & SOFTWARE
TAKAHASHI
TECH 2000 DOB DRIVERS
TECTRON
TELE VUE
TELRAD
THOUSAND OAKS SOLAR FILTERS
UNIVERSITY OPTICS
POCONO SPECIALS & MORE

COMPUTER SOFTWARE

"THE SKY" by Software Bisque

CCD Soft	$219.00
Starry Night Deluxe	$89.95
Star Chart 3	$39.95

The Sky, Level 4 Version 5 Now Available.

Max DL Imaging Software	$365.00

OBSERVE IN COMFORT with STAR-BOUND VIEWING CHAIR

- Portable, Adjustable from 9" to 32"
- Padded Seat
- Porcelain Black Powder Coated Available in Black Only

Dealer Inquiries Invited **$159.00**

TELRAD w/Base $39.00

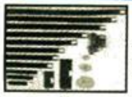
Batteries included!

Hinged Deluxe Dew Caps	$10.00
Extra Bases	$ 7.95
Extra Reticles	$ 2.95
Pulsar Unit	$19.95

RIGEL SYSTEMS

Starlite Dual LED Flashlight	$22.00
NEW Skylite: Dual Color LED Flashlight	$29.95
Quick Finder-New Version	$35.00

KENDRICK ASTRO INSTRUMENTS



Stay ahead of those soggy spring nights!

The Kendrick Dew Remover System for all size scopes, finders and mirrors

Keeps optics clear of dew, extending precious viewing time.

VISIT OUR 50+ PAGE ON LINE CATALOG WITH SECURED 24 HOUR ON LINE ORDERING AT: www.PoconoScopes.com

Look for our Monthly On-Line Specials! Call or write for our printed catalog & specials.

YOUR MEADE AUTHORIZED ADVANCED PRODUCTS MAIL ORDER DEALER

Meade Dobsonians: Available in: 6"F/8, 8"F/6,10" F/4.5, 12.5" F/4.8, 16" F/4.5, optional deluxe accessory package $49.95

New Meade ETX-90/EC and ETX-125/EC-with pushbutton electronic control comes standard with dual-axis drive system W/4 dual axis speeds. Add the Meade Autostar hand control to your scope and get fully automatic go to capability to over 12,000 objects. The ETX-125/EC has 5" of Aperture & RA Finder. Available Now.
ETX-90/EC $595.
ETX-125/EC $895.
Original ETX-90 RA $495.

ALL DS SCOPES AVAILABLE

Meade LX-200 SCT's,The World Famous "GoTo" Telescope Available in 8" F/10 or F/6.3, 10" F/10 or F/6.3, 12" F/10, 16" F/10.

ACCESSORIES FOR ETX-90 RA, EC, 125EC

#126 Barlow	$47.95
#64 T-Adapter	$34.95
#932 Image Erect Diagonal	$49.95
Hard Case for 90	$99.95
Soft Case for 90 RA & EC	$39.00
07329 #775 Hard Case for ETX-125EC	$155.00
8X25 right Angle Finder for 90	$49.95
Auto Star Hand Control for 90 &125 EC	$149.00
Equatorial Table Top Tripod (w/Hi Lat Leg)	$29.95
Equatorial Table Top Tripod (w/Hi Lat Leg) for 125 EC	$55.00
Deluxe Field Tripod	$199.00
07077#1244 El. Focus for all ETX-90 s	$119.95
07078 #1247 Elect. Focuser-ETX-125EC/S.scope	$119.95

DS SERIES ACCESSORIES

07437 #495 Autostar (hand box only)	$99.
07438 #492 Dual Motor Elect. Control System	$129.
07439 #493 Autostar, Complete System	$199.
07076 #1240 Elect. Focuser	$75.
07041 #490 Elect. Focuser	$75.
07221 #937 2 Diagonal Mirror w/.96 & 1.25 Ad	$45.
Meade 8" LX-10	**$995.**
Super Wedge	$395.
New Field Derotator for 8", 10",and 12" SCT's, and 7" Maksutov	$395.

New ETX-60 $299.& New ETX-70 $349. Now Available

NEW 8" LX-90 SCT $1695.

World Renown Series 4000™Eyepieces
Complete line in stock for immediate delivery!
NEW Meade Series 4000 8MM to 24MM Zoom Eyepiece $219.95

Tele Vue "WHEN YOU WANT THE FINEST"

We stock the entire Tele Vue line for immediate shipment. All items also on display and available for purchase and pick up at both of our showrooms.

NAGLERS 82° Apparent Field of View
Choose from 4.8 MM $175., 7 MM $220., 9 MM $240.,16 MM $310.

New Type 4 12MM Nagler $340.
Orders now being accepted for the 17MM and 22MM Type 4 Naglers

Type 5 31 Nagler $595

RADIANS 60° Apparent Field of View, 20 MM eye relief
Avail. in 3, 4, 5, 6,8, 10. 12. 14. & 18 MM $228.00

PANOPTICS 68° Apparent Field of View
15MM $210., 19MM $240., 22MM $280., 27MM (2") $330., 35MM (2") $365.

MONTHLY SPECIAL
PRONTO w/2" DIAGONALPanoramic Mount and Quick Point Finder
POCONO MOUNTAIN OPTICS EXCLUSIVE

2.5x Powermate	$168.00
5x Powermate	$168.00
New 4x Powermate now avail.	$265.
New Bino Vue	$1030.00
8MM to 24MM ZOOM	$210.00
New Everbrite 2" Star Diag.	$255.00

***NEW* TV-102 In Stock $2050.**

Ranger, Pronto, TV-85 in stock

CELESTRON

We carry the full line of Celestron Telescopes and Accessories

NEW NEXSTAR 5 & 8

JUST ARRIVED! **Flawless go-to and tracking. Superb optics, very quiet. A real winner! Nexstar 5 $1199. Nexstar 8 (with tripod) $1899.**

CELESTAR 8 DELUXE

2032 MM FL., Heavy Duty Adj. Tripod Dec Motor and Hand Control. 4 Tracking Rates and PEC Fastar Compatable. In Stock for Immediate Shipment. $1699. Celestar 8, reg. version $1099.

ULTIMA 2000

Ultra Quiet Motors and Go To Impressive Pointing Accuracy. Runs off 8 AA Batteries. Enhanced Encoder Resolution. Fastar Compatable at F-2 for CCD use. 9X50 Finder. In Stock and Impressively Priced. $2699.

DESERT STORM COVERS

Protect your investment-
Covers available for all size scopes.
Manufactured with a thick mylar "heat resistant" material

4"- 6" Dobs & SCTs	$21.95
7" -8" Dobs & SCTs	$26.95
10" -13" Dobs & SCTs	$32.95
14" SCTs	$38.95
16" -18" Dobs	$44.95
20" -25" Dobs	$54.95

Dealer Inquiries Invited

ORDERING & SHOWROOM HOURS

Penna.-POCONO MOUNTAIN OPTICS
Order: 9-9 Mon.-Fri., 9-5 Sat., 12-5 Sun.
Showroom: 10-5 Mon.-Sat., 12-5 Sun.

Las Vegas-POCONO WEST OPTICS
Order: 9:30-6 Mon.-Fri., 10-5 Sat.
Showroom: 9:30-6 Mon.-Fri., 10-5 Sat.

Prices and specifications subject to change

Penna.-**POCONO MOUNTAIN OPTICS**
104 N P 502 Plaza, Moscow, PA 18444
FAX NO. 570-842-8364 Visit our Website at: www.PoconoScopes.com
E mail: pmo@PoconoScopes.com

Las Vegas-**POCONO WEST OPTICS**
2580 S. Decatur #3, Las Vegas, NV 89102
FAX NO. 702-252-7130 Visit our Website at: www.PoconoScopes.com
E mail: pwo@PoconoScopes.com

Mention Ad A-7

ask Astro

Eclipses, F/ratios, Supernova Disasters, Ghosts

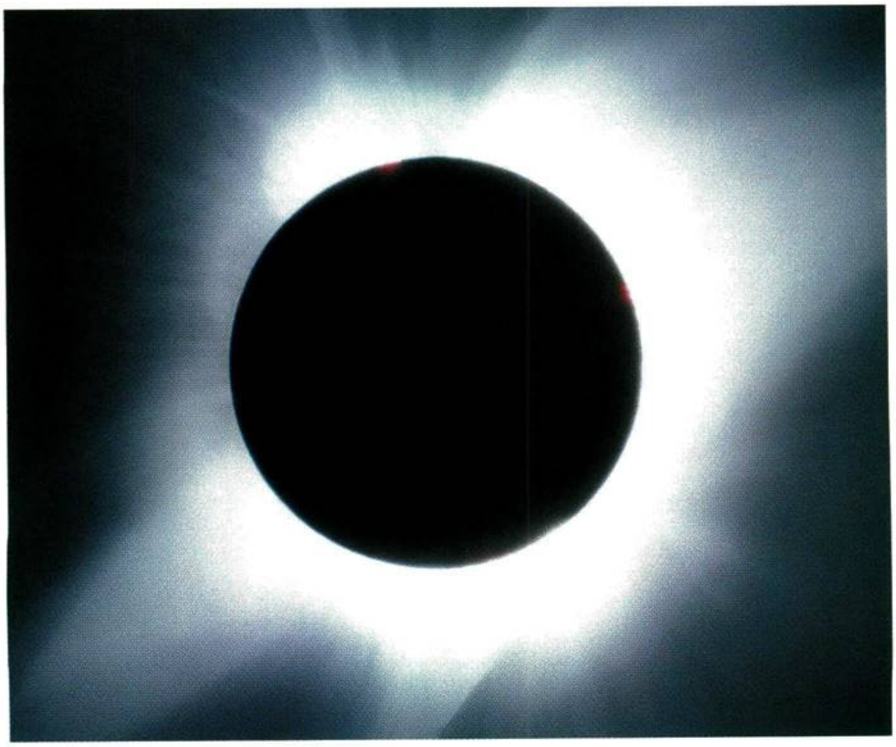
In about 50 million years, Earthlings will only see annular eclipses, like this one. Daniel Fischer

Why is the moon exactly the same apparent size from Earth as the sun? Surely this cannot be just coincidence; the odds against such a perfect match are enormous. — *Malcolm Smith, Hertfordshire, England*

Believe it or not, it actually is just a coincidence — and a happy one at that. The moon and sun have virtually the same angular size in our sky because the sun is about 400 times wider than the moon, but it's also about 400 times farther away. This allows us to see spectacular coronal displays and prominences during total solar eclipses.

Interestingly, this hasn't always been the case. Tidal interactions cause the moon to spiral about one inch per year away from Earth (for an explanation of why this happens, see Ask Astro, March 1999). In the distant past, the moon was close enough to Earth so that it could block the sun's entire disk and then some. Our prehuman ancestors would not have witnessed the beautiful coronal displays that we now enjoy. And about 50 million years from now, the moon will be far enough away so that our descendants will only see annular eclipses.

So why do we happen to live in the brief period of Earth's history when the moon just barely blocks the sun? Indeed, the odds against it are enormous. But the universe is a large enough place so that highly improbable coincidences can and do occur. It's important to note, however, that even today some solar eclipses are annular because the Earth and moon have elliptical orbits. — *Robert Naeye, senior editor*



Total solar eclipses occur because the moon and sun have the same angular size. Ernie Piini

When comparing telescopes, what does the f/ratio indicate and what is the best value? — *Andrew Scharmack, Alamogordo, New Mexico, and Larry Kirk, Gilbert, Arizona*

The f/ratio measures the "speed" of a telescope. You can calculate a telescope's f/ratio by dividing the focal length by the aperture of its objective lens or mirror. For example, a 6-inch telescope with a focal length of 48 inches has an f/ratio of 48/6 = f/8.

Refracting (lens-type) telescopes generally have "slow" f/ratios between f/8 and f/15. Reflecting (mirror-type) telescopes are usually faster, with f/ratios between f/4 and f/8 for simple Newtonians. Schmidt-Cassegrain telescopes (SCTs) generally feature f/ratios between f/10 and f/13. These longer focal lengths yield more magnification. For example, an 8-inch f/10 SCT (80 inches focal length) supplies 80 power with a 1-inch eyepiece. An 8-inch f/4 reflector (32 inches focal length) gives only 32 power with the same ocular.

There is no "best buy" when it comes to f/ratios. Your choice depends on what kind of observing you like to do. The speedy f/4 Newtonians, sometimes called rich-field telescopes, are ideal for wide-angle views of extended objects, such as galaxy clusters and emission nebulae. They also require shorter exposure times for astrophotography.

The slower SCTs give fabulous, high-power views of planets, globular clusters, and planetary nebulae.

I find that f/5 to f/8 reflectors are all-purpose workhorses that can handle a wide range of celestial targets. In fact, any f/ratio will yield satisfying views of most objects, provided that the telescope has high-quality and well-aligned optics. — *Ken Hewitt-White observes with f/4.5 and f/5.1 reflectors in British Columbia, Canada*

Astronomy: Terri Field

Are the nearby white dwarfs Sirius B and Procyon B Type Ia supernova candidates? — *Shaun Goodchild, Bodmin, England*

There are two basic kinds of supernovae. A Type Ia supernova occurs when a white dwarf accumulates gas from a binary companion until it passes a critical mass threshold and explodes. Type Ib and Type II supernovae occur when massive stars fuse their cores to iron, which then violently collapse. The energy generated during the collapse causes the stars to explode.

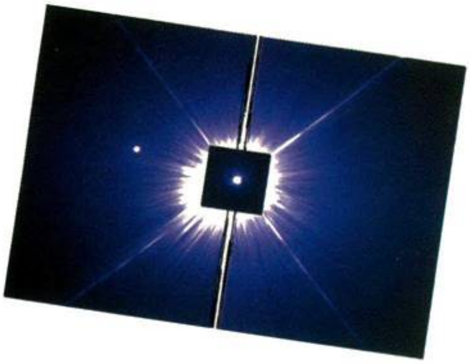
White dwarfs are the end products of stellar evolution for stars similar to the sun. White dwarfs pack about a solar mass into a sphere about the size of Earth. These dense stellar cinders are stable and cannot explode by themselves. In 1930, Indian physicist Subrahmanyan Chandrasekhar discovered that white dwarfs cannot support themselves if their masses exceed 1.4 solar masses. If a white dwarf gets pushed over the edge, it will collapse and then explode like a giant hydrogen bomb.

The easiest route to this catastrophe is to place a white dwarf so close to a normal star in a binary system that it will tidally distort the normal star and draw mass onto itself. This phenomenon produces ordinary novae when the freshly deposited surface layers explode. But if the white dwarf is already close to the edge, it might be pushed over and instead explode as a Type Ia supernova.

Neither Sirius B nor Procyon B are massive enough nor close enough to their companions to qualify. The most likely candidates seem to be the rare "recurrent novae," which pop off every few decades. The best choice might be 18th-magnitude U Scorpii, in which a white dwarf orbits a solar-type star (or maybe a giant) every 1.2 days. This short period implies an orbit only a few solar radii across. Sirius B, on the other hand, takes 50 years to go around Sirius A and has an orbit bigger than that of Uranus. Procyon B, with a 41-year period, is similar.

Fortunately, no such dangerous stars are nearby. U Scorpii is at least 10,000 light-years away. The rarity of such stars is consistent with the rarity of galactic supernovae, which explode at a rate of perhaps only one or two per century. The nearest Type II supernova candidate, Betelgeuse, is a safe 520 light-years away. So don't worry about any type of supernovae harming Earth. — *Jim Kaler, University of Illinois. He describes a new star each week on his website www.astro.uiuc.edu/~kaler/sow/sow.html.*

This composite of two Hubble images shows Procyon A and its faint white dwarf companion, Procyon B. Howard Bond (STScI) and NASA



Why does a full moon always bring out ghosts, goblins, and other assorted scary creatures? — *Joseph Daudish, Westchester, Illinois*

It only seems that a full moon brings out ghosts, goblins, and other assorted scary creatures. It's just an illusion. Scary creatures are always around us, but we can't see them as well on a dark night. — *William Sheehan, author of forthcoming books on the moon and Mars*

As Halloween approaches, the editors of *Astronomy* would like to read your answer to this question. Write to Ghosts, *Astronomy*, P.O. Box 1612, Waukesha, WI 53187.

CONTACT INFO

Send your questions via e-mail to: askastro@astronomy.com; or write to: Ask Astro, P.O. Box 1612, Waukesha, WI 53187. Please tell us your full name and where you live.

IDENTI-VIEW™
PREMIUM GLASS SOLAR FILTERS

- SAFE • HIGH QUALITY
- STRICT CONTROL STANDARDS
- LIMITED LIFETIME WARRANTY

CLASS "A"
Color band - blue. Class "A" filters are made with the same premium quality polished glass and multi-alloy coating as Class "B". An additional steel alloy added to the coating process makes our Class "A" filters extremely scratch and fade resistant. Excellent for visual and photographic use. Light transmission is 1/1000th of 1%.

CLASS "B"
Color band - white. Class "B" filters are made with polished glass and multi-alloy coating. These filters offer great durability and will provide many years of service and enjoyment with normal use. Can be used visually and for photography. Light transmission is 1/1000th of 1%.

CLASS "C"
Color band - red. Class "C" filters are specifically coated to a lighter density (ND-4). They are for photographic use only. This filter is intended for use by professionals and serious hobbyists. Light transmission is 1/100th of 1%.

ORDERING INFORMATION

1. State scope brand and model number, aperture and outside diameter with filter class and price.
2. Make check or money order payable to J.M.B. Inc. All foreign checks must be payable through a U.S. bank.
3. Shipped free within the continental United States. All others add $5.50 Shipping and Handling per filter. Michigan residents add 6% sales tax, allow 2-3 weeks for delivery.

VISA **J.M.B. INC.** MasterCard
736 Oak Glen Circle • Fall Branch, TN 37656
(423) 348-8883 • FAX (423) 348-6389
"Imitated but never duplicated"

The Fujinon Constellation

FUJINON
TECHNO-STABI

Named one of the year's 25 top astronomy products, Fujinon's 14x40 Techno-Stabi™ ends the jittery images associated with high power, handheld binoculars. Using an advanced digital stabilizing system so effective, it even permits making observations from boats, planes and helicopters. It is also the only 100% waterproof image-stabilizing binocular.

Flat-field Polaris™ Series binoculars give you the world's brightest, high-resolution images. *Sky & Telescope* said the 7x50 was "incredible" and unlike the competition, had longer (23mm) eye relief and a tripod adapter socket. Polaris distortion-free optics increase the useful field area more than 40% by eliminating defocused star images near the field stop. Polaris Series: 7x50,10x70 and 16x70. 100% waterproof. Mil Spec. Lifetime limited warranty.

Fujinon's exclusive 25x150 and 40x150—the world's largest production binoculars—have earned the title "Comet Finder" (the most recent find being Hyakutake). Their incredible optics let you enjoy the widest, sharpest and brightest high-contrast views of globular clusters, galaxies and delicate nebulae detail. Also available with extra low dispersion ED glass. 100% waterproof. Mil Spec. Lifetime limited warranty.

FUJINON INC.
10 High Point Drive
Wayne, NJ 07470
(973) 633-5600 FAX (973) 694-8299

FUJINON

OBSERVER ASTRONOMY TENT

ZIP OUT ROOF
EASY SETUP
DURABLE
PORTABLE
RAINFLY
ROOMY

$390.00

SHELTER-DOME TENT

Optional rain fly $95.00

4 ZIP OUT SLOT
LIGHTPROOF
FAST SETUP
PORTABLE
DURABLE
ROOMY

$375.00

OBSERVING CHAIRS

ULTIMATE......$125.00 **ULTIMATE II...$160.00**

Ultimate II has a folding accessory tray for eyepieces filters, charts etc.

Made from Baltic Birch Plywood.

Seat is adjustable from 9" to32"

Buy Direct of from your Favourite Dealer!

KWIK FOCUS

BEFORE
AFTER

ETX............$30.00	AP 155mm..$35.00	10" SCT........$45.00
C5..ETX 125....$30.00	7" Mak........$40.00	11" SCT........$50.00
AP 105mm..$30.00	8" SCT........$40.00	12" SCT........$55.00
AP 130mm..$30.00	9.25" SCT.....$45.00	14" SCT........$60.00

LASER COLLIMATORS

Collimators for Schmidt Cassegraines and Newtonians

1.25" $100.00
2" $110.00
SCT.......$160.00
SCT NGF-S.....$175.00
Difractive optic collimator $175.00

SUN FINDER

Fits over your Telrad. Find and center the sun in your eyepiece in seconds!!..................**$30.00**

CORONADO INSTRUMENTS H - ALPHA SOLAR FILTERS AND TELESCOPES-FULL LINE

DEW REMOVER SYSTEM

controller	$70.00	Telrad heater	$23.00
.965"	$33.00	Telescope computer control heater	$35.00
1.25"	$35.00	**Felt lined Flexible Dewcaps**	
2"	$38.00	ETX	$25.00
3"	$40.00	C5 / ETX 125	$32.00
4"	$43.00	6"	$42.00
5"	$45.00	7"/C8"	$50.00
6"	$48.00	C9.25	$55.00
7/8"	$50.00	10"	$60.00
9/10"	$60.00	C11"	$70.00
11"	$65.00	12"	$85.00
12"	$70.00	C14"	$105.00
14/16"	$80.00		

DEWCAPS

Flexible, Felt lined, Durable.
Save up to 85% vs Brand Name.

BATTERIES

12V 17 AMP HOUR
Comes with float charger, carry bag, built in fused cigarette lighter power socket. **$125.00**

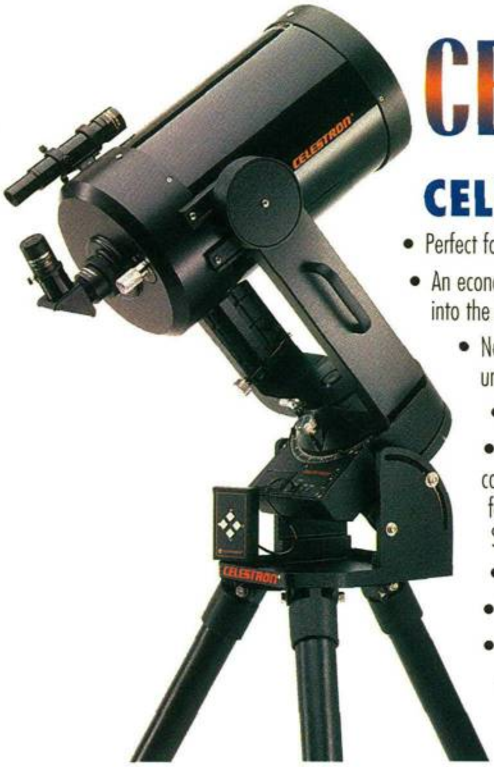
33 AMP HOUR BATTERY
4 fused power plugs, LCD for state of charge,
1 amp float charger, carry bag
Comes in two configurations
12 volt......$290.00
18 volt......$390.00
18 volt version is for LX 200 owners.
One plug has a built in inverter for 18 volt output.

We accept all major credit cards

KENDRICK ASTRO INSTRUMENTS

2920 Dundas St. West, Toronto, Ont M6P 1Y8, Canada
Tel 416 762 7946 Fax 416 762 2765
kendrick-ai.com email: kendrick@kendrick-ai.com

CELESTAR 8 TELESCOPES



CELESTAR 8

- Perfect for a first time astronomer.
- An economical but full featured 8" (2032mm f/10) Schmidt-Cassegrain. A considerable amount of engineering work went into the design of the Celestar 8.
- No sacrifice was made in the optics. Celestron's carefully hand-figured system delivers diffraction-limited optics of unsurpassed quality. Starbright® coatings are standard.
- The energy efficient DC electronics are powered by a 9 volt alkaline battery for easy astronomy on the go.
- The totally cordless electronics have a built-in drive corrector which is activated when using the optional hand control. The R.A. motor's main tracking speed is an accurately regulated sidereal rate. The optional hand control allows for fast and slow override of R.A. tracking speed and ± operation of the optional DEC motor. A comment from the Sky & Telescope review – "the digital electronics delivered a near-perfect sidereal tracking rate."
- The Celestar 8 drive can operate in the Northern or Southern hemisphere from 0° to 90.°
- The unique Wedgpod is a combination tripod and wedge which is very stable.
- Made in the U.S.A.
- Standard accessories include: 6x30 Finderscope, Star Diagonal – 1¼" and a 25mm SMA Eyepiece – 1¼" (81x).
- Weight – 41 pounds.

CELESTAR 8 DELUXE

- For the more serious astronomer.
- This telescope utilizes the same superior optics and has all the features of the Celestar 8, but is enhanced, for those who prefer a premium version.
- This model has a heavier duty fork mount and drive base, with a precision worm gear drive system.
- Superior tracking accuracy is attained with this advanced drive system, which has four tracking rates and PEC (Periodic Error Correction).
- For the kind of versatility that makes observing a pleasure, the hand controller makes available a micro guide rate of .5x sidereal and a slew rate of 8x sidereal.
- The stepper motor drive electronics are cordless and operate on two 9 volt batteries.
- The Celestar 8 Deluxe has many features that are necessary for the more serious amateur astronomer, particularly if you're interested in astrophotography or CCD imaging with the PixCel or other CCD cameras.
- Fastar compatible for f/1.95 CCD imaging – deep sky images in 30 seconds or less!
- Made in the U.S.A.
- The standard accessories for this telescope include: Declination Motor, Car Battery Adapter, Hand Controller, Wedge and a Tripod with adjustable height that's exceptionally rigid and sturdy .
- Also standard is a large 9x50 Finderscope, Star Diagonal – 1¼" and a multi-coated 26mm Plossl Eyepiece – 1¼" (78X).
- Weight – 52 pounds.

ADVANCED ASTRO MASTER®

CELESTRON
Advanced Astro Master

The Celestar 8 Computerized and the Celestar 8 Deluxe Computerized telescopes are the same as the Celestar 8 and Celestar 8 Deluxe but with the addition of a factory installed and tested Advanced Astro Master.®

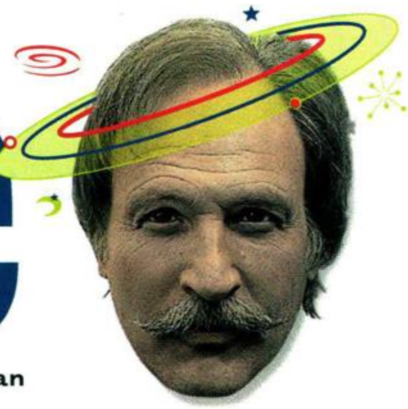
Its pointing system contains a data base of over 10,000 objects. Once aligned, it will guide you to any one of these objects. Included are the entire RNGC catalog, the Messier catalog, IC catalog (selected objects), major planets, over 241 interesting double and multiple stars and a user definable catalog of 25 objects. Operates on a standard 9V battery.

Contains an RS-232 serial interface to enable usage with programs like "The Sky"™ by Software Bisque.

For more detailed information on these telescopes, contact a Celestron dealer or Celestron. **Visit our Web site at www.celestron.com**

CELESTRON® 2835 Columbia Street, Torrance, CA 90503 • (310) 328-9560 • FAX (310) 212-5835

strange Universe



by Bob Berman

Astro Blunders

You've probably all noticed astro blunders on TV, movies, and in print. I've made my share, despite face-saving help from editors and fact-checkers, those unsung heroes. Still, there's a strange repetitiveness to many of the most common mistakes that raises them almost to the level of myth.

The first day of autumn brings an example to mind. We're told each year that days and nights are equal on the equinox. But if you look at your local newspaper listing for that day's sunrise and sunset, you see they don't match. Depending on your latitude, between 4 and 14 minutes more of sunshine than night occur on the equinox. Yet the interesting phenomena that are true on the equinox (e.g. the sun rises and sets precisely in the east and west) aren't usually mentioned.

Day and night *would* be equal if Earth didn't have an atmosphere that bends the sun's image upward by its own diameter whenever it's on the horizon. When the sun sits at the skyline it's really already gone. We see a phantom, a daily imposter, at dusk and at dawn. This "ghost" sun delivers several extra minutes of daily sunshine.

This equinox business may be a case of sloppiness rather than outright blunder. True astro goofs are another story and so prevalent they can seem more comic than cosmic to knowledgeable amateurs — as when TV depicts a comet whooshing across the sky, or when total solar eclipses are said to make everything pitch-black.

It took nearly a century for the public to realize that Mars doesn't have canals, and some still think that the moon doesn't spin or that Mercury has a frozen rotation. But the major persistent myths, the ones that make backyard astronomers slap their heads and groan, probably number just one or two dozen. We should make a list and send it to our colleagues in the media. They can post it on some office wall with a request: Stop saying these things!

Water does *not* spiral down drains in different directions in different hemispheres. It goes down randomly. Little imbalances in a sink or toilet's levelness or the direction of incoming water totally overpowers the Coriolis effect caused by Earth's rotation.

Leap seconds are *not* needed because Earth's rotation slows down by a second every year or two. If Earth's spin decreased that quickly, we would have ground to a halt eons ago. Leap seconds are mainly required because of the disparity between different time-monitoring systems. A day actually gets just 1/500 of a second longer after a century.

A telescope does not "have" a particular "power."

Comets do not visibly appear to move.

Space shuttle astronauts do not float around because they have escaped Earth's gravity. Even many teachers get this wrong. Nearly as much gravity exists 250 miles high as it does on the surface. Astronauts feel weightless for the same reason that skydivers do — because they are falling freely.

The moon does not pull on water or the oceans any more than it pulls on your pet hamster. But because water can flow, it can be easily displaced, which gives rise to the tides.

There is no increase in births at the time of full moon.

The moon does not have a permanent "dark side" any more than Earth does. Sci-fi books and movies and Pink Floyd fans often allude to the "dark side" of the moon when they really mean the "far side."

Jupiter was *not* "almost a star." Even if it had 70 times more mass than it does, it could not sustain the nuclear fusion in its core that would cause it to shine like a star.

Meteorites are not hot when they land. In 1991, one smashed into a lawn next to two boys in Noblesville, Indiana, who immediately picked it up. They described it as slightly warm to the touch. A meteor's surface gets plenty hot when incandescing 40 miles up, but the lower atmosphere's subzero temperatures cool it before it lands.

From Pluto, the sun is not "just a bright star." The sun would be a point of light about 300 times brighter than the full moon — too dangerous to look at.

The analogy of planets orbiting the sun and electrons orbiting an atomic nucleus is poor. Among other things, atoms are a thousand times emptier than solar systems relative to their components.

Black holes do not go around sucking up stars or planets; their diet consists almost entirely of nearby subatomic particles. If our own sun collapsed into a black hole (which is not possible), Earth would continue to orbit it just as before. We would not be pulled in. In fact, we wouldn't experience the slightest increase in the sun's "pull," because its mass would remain unchanged. But of course we would freeze to death.

The northern lights are not particularly colorful. Spooky, animated, incredible — yes. But many say they see no color at all, while most perceive a pale green. Subtle pink fringes are sometimes detected, but a deep red aurora is extremely rare. This myth is probably created by color photography, which brings out faint tints.

Radio telescopes do not detect sound waves. Nonetheless, people using them are almost always shown wearing headphones as if they're listening to something (as in the movie *Contact*).

Those are some of the most common errors perpetuated by the media. Lay people repeat many more. For example, most folks are amazed to learn that only about 3,000 naked-eye stars can be seen at any given time from a dark location. A rural sky seems crowded with "millions" of stars.

Despite how it's depicted in movies, the asteroid belt is so empty of asteroids that NASA could send a thousand spacecraft blindly through the belt without much chance that one would hit anything. In fact, NASA directed Galileo so it would encounter asteroids Gaspra and Ida.

Galaxies are mostly empty space. Stars are separated by such large distances that even when galaxies collide, their individual stars almost never do.

Contrary to popular perception, the universe has no center, just as the surface of a balloon has no center.

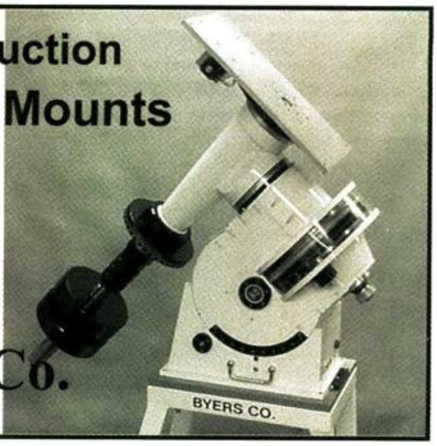
Because the Big Bang created both space and time, it makes about as much sense to ask what happened before the Big Bang as it does to ask what is north of the North Pole.

The public also imagines that professional astronomers look through telescopes. The media perpetuate this myth by commonly having astronomers pose at the eyepiece.

The moon's size is another traditional source of error. Cartoonists make it enormous as it floats above lovers in parked cars. Ask a friend how many moons must be piled on top of one another to stretch from horizon to zenith and the usual answer is between 15 and 50. The reality: 180. The moon is far smaller than people imagine or remember it to be.

But these last few items are more like illusions than errors, not in the same class as zooming comets. What's odd is that these same misconceptions, numbering just a few dozen, are so persistent — a kind of "constant" like the mass of the proton. Many were around when I studied astronomy in the 60s. And I'll bet someday in the future when our grandkids buy their first telescopes, their friends, sure enough, will want to know its power. ■

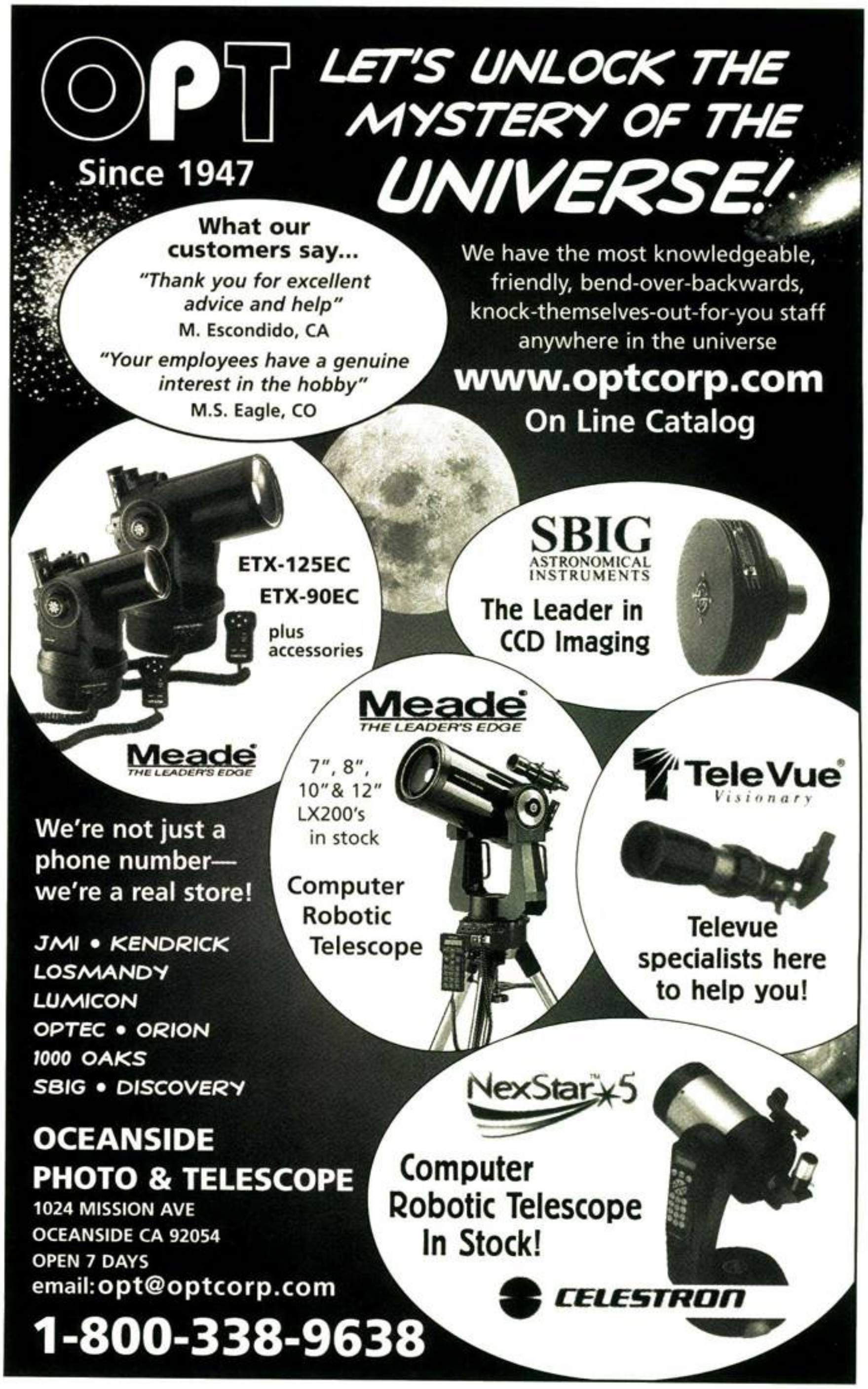
Bob Berman's Strange Universe column is a monthly feature in Astronomy *magazine. Berman is the author of* Secrets of the Night Sky *and* Cosmic Adventure.



New Year 2000 production
BYERS Series II Mounts

Research quality.
With analog circles
(as shown) or digital
position display. (See at
www.hardin-optical.com)

Hardin Optical Co.
Call toll free: 1-877-447-4847



OPT
Since 1947

LET'S UNLOCK THE MYSTERY OF THE UNIVERSE!

What our customers say...
"Thank you for excellent advice and help"
M. Escondido, CA
"Your employees have a genuine interest in the hobby"
M.S. Eagle, CO

We have the most knowledgeable, friendly, bend-over-backwards, knock-themselves-out-for-you staff anywhere in the universe

www.optcorp.com
On Line Catalog

ETX-125EC
ETX-90EC
plus accessories
Meade THE LEADER'S EDGE

SBIG ASTRONOMICAL INSTRUMENTS
The Leader in CCD Imaging

Meade THE LEADER'S EDGE
7", 8", 10" & 12" LX200's in stock
Computer Robotic Telescope

TeleVue Visionary
Televue specialists here to help you!

We're not just a phone number— we're a real store!

JMI • KENDRICK
LOSMANDY
LUMICON
OPTEC • ORION
1000 OAKS
SBIG • DISCOVERY

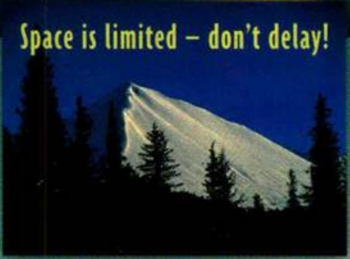
NexStar™5
Computer Robotic Telescope In Stock!
CELESTRON

OCEANSIDE
PHOTO & TELESCOPE
1024 MISSION AVE
OCEANSIDE CA 92054
OPEN 7 DAYS
email:opt@optcorp.com
1-800-338-9638

JOIN Astronomy MAGAZINE ON A

Northern Lights Tour

Alaska
March 17-26, 2001



Space is limited – don't delay!

Chase the colorful curtains of the aurora borealis through Alaska's interior with Astronomy Magazine. Along with catching one of the most spectacular views of the night sky, you will experience the magnificent vistas of a great, unspoiled wilderness.

Our experience begins with five nights in Fairbanks, one of Alaska's major urban centers that still maintains a pioneering spirit. You can arrange to shop, downhill ski, attend the Ice Festival, or simply curl up with a good book.

The adventure continues in Chena Hot Springs, 60 miles from Fairbanks, and far from light pollution. The evening aurora should produce an impressive show as solar activity is expected to be high in March 2001. During the day, you can take advantage of cross-country skiing, snow shoeing, and ice-skating. Or relax in the world-famous hot springs.

The breathtaking scenery is guaranteed to put you on sensory overload. Whatever your choices for the daylight and evening hours, pack your warm clothes and join Astronomy on this watch for the magical northern lights in the heart of Alaska. See you there!

For more information call Specialty Tours today at: 1-800-677-9412 (US only) or 727-796-7555
E-mail: gs@alspecialtytours.com

Online Catalog/Ordering @ shutan.com

We sell a complete selection of new and pre-owned Meade ETX telescopes priced from $299⁹⁵

70/AT
We buy used ETX's!
90/RA
60/AT

90/EC • 125/EC
Call for Sale prices!

Meade 8 inch Dobsonian **$349!**

Meade 10 inch Equatorial **$699!**

$500⁰⁰ Price Drop Call for info!!

Meade LX90 & LX200

Celestron NexStar-5" & 8"

18,000-object GOTO database!

We stock NexStar cases tripods, and more!

Huge Selection of In-Stock Meade Eyepieces and Accessories!

Multi-Coated!

Meade 3000 Eyepieces

Plossl 5, 6.7, 9.5, 16, or 25mm	$50
40mm Plossl	80

Meade 4000 Eyepieces

Super Plossl 6.4, 9.7, 12.4, 15, 20, 26	80
SP32 or 40mm	100
SP56mm	200
Super Wide 13.8	140
Super Wide 18	150
Super Wide 24.5	180
Super Wide 32	240
Super Wide 40	300
Ultra Wide 4.7	170
Ultra Wide 6.7	200
Ultra Wide 8.8	240
Ultra Wide 14	300

ETX Accy's:

Barlow Deluxe APO	$80
Case, soft deluxe	80
Case, hard 90	100
Case, hard deluxe	159
Dew shield sliding	32
Easy-Mount	59
FlexFocus	36
FieldPod-Bogen	159
KwikFocus 90	32
KwikFocus 125	32
MegaPod	239
MotoFocus	100
MotoFocus/Dec	170
Power Package	100
Piggyback 90	62
Piggyback 125	72
Rigel Quickfinder	40
SCT accy adapt	32
SkyMap Pro 6.0	95
Solar filt-dlx-90	82
Solar filt-dlx-125	104
Tele extender	32
Visual back 1.25"	32
Wide-field/deluxe	100

Meade ETX Accy's:

Autostar #497	$150
Ac adapter #541	42
Car cord #607	28
Computer cord #505	26
Case,soft #765	42
Case, hard #773	100
Case, hard #774	100
Case, hard #775	150
Elec focus #1244	Sale
Elec focus #1247	124
Finder 8x25	52
Latitude wt. #1422	30
Prism 45° #932	50
Prism 45° #933	50
Skychart software	55
Tripod- table #880	33
Tripod- table #881	64
Tripod- DlxEq #883	200
T-adapter #64	37

Misc. Meade

AC #541	$42
AC #542	110
Barlow 2x #140	80
Car cord 18 volt	87
Case 7/8/10/12"	call
Compass #605	21

Misc. Meade

Deluxe lat adjust.	$26
Eyepiece holder	26
Epoch 2000 CD	179
Flip-mirror #644	150
Flip-mirror #647	250
Finder 544-8x50	72
Finder 545-8x50	72
Finder 634-6x30	52
Finder brkt-8x50	26
Filter sets of 4	50
Filter ND96 1.25"	20
Focal reducer f:6.3	130
Focal reducer f:3.3	150
Illum 12mm Astro	120
Illum 12mm-CCD	130
Illum 12mm w/cord	80
Illum 12mm-wless	100
Illum 9mm w/cord	130
Illum 9mm-wless	150
Lenshood 7/8"	114
Lenshood 10"	124
Lenshood 12"	174
Magellan	call
Micro-Az control	28
Motor 531/532	104
Nebula 908 B	80
Nebula 908 N	90
Nebula 908 O-III	100
Nebula 911 B	100
Nebula 911 N	120

Misc. Meade

Nebula 911 O-III	$150
Off-axis standard	82
Off-axis deluxe	110
Pictor 201XT	399
Pictor 208XT	499
Pictor 216XT	699
Pictor 416XTE	1999
Pictor 616 filter	699
Piggy brkt 7/8"	34
Piggy brkt 10"	34
Piggy brkt 12"	50
Polar finder 812	50
Prism 2" 90°	105
Prism 1.25" 90°	45
Prism .96-1.25"	32
Prism 1.25" 45°	45
Skylight/seal	50
Tele extender	30
Tele ext-variable	40
T-adapt: SCT	30
T-adapt: vari-proj	40
T-adapt: 1.25"	30
Vari pol 905	50
Weight set 7"	92
Weight set 8"	92
Weight set 10"	99
Weight set 12"	109
Wedge 8"	134
Wedge Super	399

Call for other items!

Book & Star Charts

40 More Books & Descriptions @ www.shutan.com

Astrophotography/Amateur	320 pgs.	$35
Astrophotography Introduction	192 pgs.	20
Art & Science of CCD Imaging	176 pgs.	40
Cambridge Guide Stars/Planets	256 pgs.	16
City Astronomy	176 pgs.	19
Deep-Sky Introduction	272 pgs.	25
Messier Album	248 pgs.	22
Monthly Star Charts	68 pgs.	25
Nortons 2000.0	192 pgs.	30
Sky Atlas 2000.0 Deluxe	704 pgs.	50
Telescopes & Techniques	204 pgs.	26
Turn Left at Orion	205 pgs.	25

***Canon* *Image Stabilized* Binoculars!**

10x30 • 15x50 • 18x50

We stock 70+ models of binoculars! See 'em at www.shutan.com

Lumicon Filters!
Deep Sky • O-III H-Beta • UHC

Misc.

1000 Oaks 1.25" Light Pollution Filters:

B-band/N-band	$90
O-III/H-Beta	90

Schmidling

Easy Tester	32

Laser Collimator

at www.shutan.com	100

Rigel

Skylight red/white	30
Quickfinder	40

Starbound

Astro Chair	160

Losmandy

GM-8 w/motor	1465
G-11 w/motor	1865
Dove plate 8"-11"	90
Dove plate 12"	135
125mm ring set/2	160
DCM mount	80

Telrad!

$42

Solar

Solar Filters!

Top-rated! Precision polished **Class-A** glass, triple-coated. Machined aluminum cell. Image is yellow-orange— no need for secondary filtering!

ETX-90mm	$82
ETX-125mm	104
NexStar-5	104
6" full aperture	119
8" full aperture	139
10" full aperture	159
12" full aperture	189

Kendrick

Dew Removers

12v Controller	$70
110v adapter	65
1.25" heater	37
2" heater	39
3" heater (ETX)	42
7/8" heater	52
9"/10" heater	62
12" heater	72

Dew Shields!

ETX-90mm	27
7"/8"	54
10"	64
12"	85

Kwik Focus!

ETX-90mm	33
8"	47
10"	57

JMI

Zero-Image Shift Focusers!

For ALL 8", 10", 12" Meade or Celestron Schmidt-Cassegrains!

NGF-S:

w/built-in motor!	$264

Eliminate the wiggles!

NGF3 Mini 1.25"	99
NGF DX3 2-inch	159
Leveling wheely bar for Meade 8" or 10" Schmidt-Cass	159
For 12" SCT	199
Keypad holder for LX200's	34

Celestron

8" SCT's from **$999!**

Celestar-8	$1099
Celestar-8 Deluxe	call
Ultima 2000	call
New! G8N 8" Newtonian	699
New! CR-150HD 6" Refractor with CG-5 mount	1199
G5 Deluxe w/Quartz motor	799
G8 8" SCT w/mount	999

Ultima 2x APO **$80**

6.3 Reducer **$130**

7x50 Ultima	$249
8x56 Ultima	299
9x63 Ultima	359
10x50 Ultima	259
20x80 Deluxe	469

Pentax

65° Field!

7mm	$269
10.5 or 14mm	259
21mm	259
28mm	249
40mm (2")	269

LX200 *Easy-Mount*

11.5" x 20"
$99

- A must for all LX owners
- Fits 7"-12" Meade scopes
- Bumper-type registration
- 1/4" anodized alum-CNC
- Holds 12 eyepieces!
- Holds keypad securely

TeleVue-101 • TeleVue 85 Pronto • Ranger

Quick Point	$40
Starbeam-T	180
2" diagonal SDG	190
1.25" 90° diag	80
Field Flattener	88
BinoVue New!	1030
TelePod w/tripod	325
Paracorr 2"	235
Zoom 8-24mm	214

Plossl-50°

8, 11, or 15	84
20 or 25mm	97
32 or 40mm	114
55mm	230

Radian-60°

3, 4mm ea.	230
5, 6, 8mm ea.	230
10, 12mm ea.	230
14, 18mm ea.	230

Panoptic-68°

15mm	$210
19mm	240
22mm	280
27mm	330
35mm	365

Nagler-82°

4.8mm	175
7mm	220
9mm	240
12mm Type4	340
17mm Type4	370
22mm Type4	445
31mm Type5	599

Barlows

1.25" 2x or 3x	109
1.25" 2.5x or 5x	180
2-inch 2x	170
2-inch 4x	265

2000
SHUTAN

Order Toll-Free or Online! Call us or visit our web site for **Y2000 Discount Catalog!** Order by **NOON** for same-day shipment. C.O.D. available, please inquire. We ship most accessory orders up to 5 lbs. for just **$7** via UPS Ground. **Non-Meade** products are available for **Worldwide** shipment-- information at www.shutan.com. Shutan is family **owned** and **operated** since 1918! Prices, specifications, and trade-in offers subject to change and do not include shipping/handling. **© 7/2000 SC&V.**

SHUTAN
camera & video

We welcome bids & PO's from Schools!

Toll-Free 800-621-2248
Illinois 847-367-4600 • www.shutan.com
100 Fairway Dr. • Vernon Hills IL • 60061

We Moved!

PRODUCTS

Pocket Planetariums

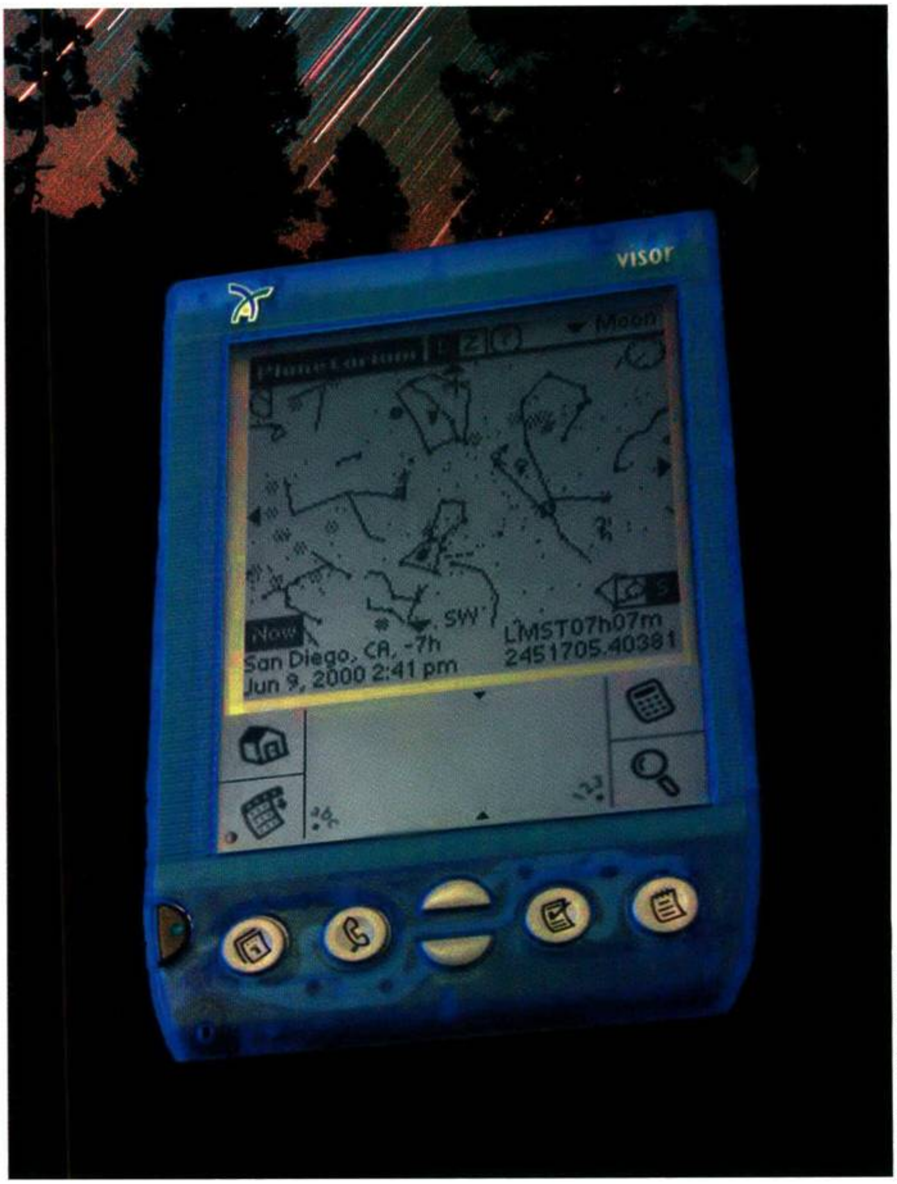
Imagine holding a database in one hand with hundreds of stars, Jupiter's moons, and the Messier Catalog. Now you can, using astronomy software written for many handheld devices such as the Palm Pilot Personal and Handspring Visor. Check out this pocket-full of popular shareware programs, which are available for free. All these programs require the PalmOS v.2.0 operating system, or a later version. (Location manager shareware or other free software may also be needed.) If you like any of the programs and plan to use them regularly, the providers ask that you pay a fee to register, which usually includes free updates and, in some cases, more fully loaded versions.

Planetarium
What is Planetarium?

Planetarium

▶ This program calculates the position of the sun, moon, the nine planets, and 1,600 of the brightest stars for any time and geographical location. You can even use it as a compass when the sun or moon is visible. The Compass View shows which of the planets are above or below the horizon at any given time and it also tells you their azimuths and altitudes. Rise and set times are calculated for the planets, as well as civil, nautical, and astronomical twilights. Use the Sky View to display an image of the planets and brightest stars, with or without constellation lines. You can even add your own favorite objects to its database, and define time-step increments.

Aho Interactive Software; website, http://www.aho.ch/pilotplanets/; memory required, 91 KB; $19.



David Cortner and Nancy Hendrickson

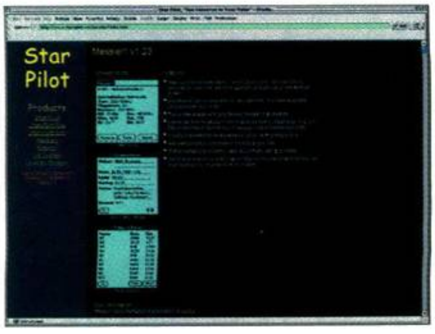
Pocket Star Chart 1.1

▶ This simple charting software plots the positions of 1,631 stars to 5th magnitude, the planets, sun, moon, and local horizon for any location and date (1904 to 2031). The gray-scale display adjusts for urban or rural views with constellation lines and names. You can customize the views with a stylus and toggle between skies in the Northern and Southern Hemispheres.

Kevin S. Polk; website, http://www.in2space.com; memory required, 170 KB; operating system, Palm OS v.2.05 or greater, HotSynch manager 3.0 (Windows), or Open Palm Desktop 2.0; $17.95.

Star Pilot (v2.30)

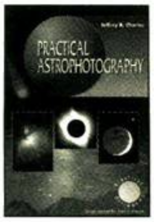
▶ Imagine your desktop planetarium program shrunk to pocket size, and you have Star Pilot. The display database includes 740 stars, the planets,



Springer Guides to the Universe

J. CHARLES, Versacorp, Pasadena, CA

Practical Astrophotography



Practical Astrophotography looks at all the options available to amateurs for capturing images they see through their telescopes, including normal photography, CCD imaging, and modern techniques of computer enhancement. There are sections about photographing different classes of astronomical objects, from the moon to faint nebulae, as well as a thorough look at the equipment needed.

2000/230 PP., 71 ILLUS./SOFTCOVER/$34.95/ISBN 1-85233-023-6
PRACTICAL ASTRONOMY

P. WLASUK, Florida International University, Naples

Observing the Moon

Regardless of whether they own a big expensive telescope or simply binoculars, moon-watchers will find a tremendous amount of information in this guidebook. And because Peter Wlasuk discusses the geology of the Moon in relation to what can be seen, *Observing the Moon* adds an important extra dimension to this most popular branch of amateur astronomy. A bonus CD-ROM contains a gallery of images of lunar features and helps make this definitive guide an essential companion to observing the Moon.

2000/APPROX. 192 PP., 106 ILLUS., CD-ROM/SOFTCOVER/$39.95/ISBN 1-85233-193-3
PRACTICAL ASTRONOMY

S. COE

Deep-Sky Observing

The Astronomical Tourist

This book gives detailed practical advice about how to find the best observing site, how to make the most of the time spent there, and what equipment and instruments to take along. There are comprehensive lists of deep-sky objects of all kinds, along with Coe's own observations describing how they look through telescopes with apertures ranging from 8 - 36 inches (0.2 - 0.9m).

2000/APPROX. 210 PP., 180 ILLUS./SOFTCOVER/$34.95/ISBN 1-85233-627-7
PRACTICAL ASTRONOMY

S. CLARK, University of Hertfordshire, UK

Life on Other Worlds and How to Find It

Providing a welcome review of this on-going area of re-investigation, this first up-to-date summary of scientific research highlights the concerns and current discussions relating to the search for extraterrestrial life. The book highlights the philosophical concerns accompanying the possible confirmation of other life forms in our universe, and discusses the physics and biological aspects of possible life on other worlds.

PRAXIS **2000/179 PP., 28 ILLUS., 3 TABLES/HARDCOVER/$32.95/ISBN 1-85233-097-X**
SPRINGER-PRAXIS SERIES IN ASTRONOMY AND SPACE SCIENCES

O. MONTENBRUCK, Wessling, and **T. PFLEGER,** Hennef, both, Germany

Astronomy on the Personal Computer

Fourth Edition

This revised edition provides the reader with a thorough introduction to the computation of celestial mechanics by supplying the necessary knowledge and software solutions (in C++) for determining and predicting positions of the Sun, Moon, planets, minor planets and comets, solar eclipses, stellar occultations by the Moon, phases of the Moon, and much more. The accompanying CD-ROM contains executable programs for Windows 95/98/NT and Linux operating systems.

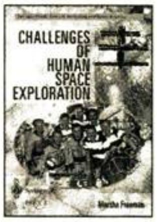
2000/310 PP., 46 ILLUS., CD-ROM/HARDCOVER/$54.95/ ISBN 3-540-67221-4

Springer

www.springer-ny.com

M. FREEMAN, 21st Century Science & Technology, Washington, DC

Challenges of Human Space Exploration



This book tells the story of what was accomplished during the Shuttle-Mir program, based on the interviews granted to the author by three of the astronauts. It focuses on their descriptions of the human aspects of the exploration of space and their attempts to solve problems both mechanical and interpersonal. It also describes the experiments in growing crystals, food, and tissue which they undertook during the Apollo/Soyuz and Shuttle-Mir programs and the lessons learned.

PRAXIS **2000/APPROX. 400 PP., 65 ILLUS./SOFTCOVER/$44.95**
ISBN 1-85233-201-8
SPRINGER-PRAXIS SERIES IN ASTRONOMY AND SPACE SCIENCES

B. ABRAMS, Gloucestershire, UK, and **M. STECKER,** Los Angeles, CA

Structures in Space

Hidden Secrets of the Deep Sky

Through the medium of Michael Stecker's strikingly beautiful photographs and electronic images, *Structures in Space* explores the organization of the universe from the solar system to distant galaxies. The accompanying CD-ROM contains over 100 dramatic astronomical .JPEG images to supplement those in the book. You can view them on your personal computer, or print them out on a photo-quality color printer to create your personal collection of prints.

2000/116 PP., 42 ILLUS. (12 IN COLOR), CD-ROM/SOFTCOVER/$39.95/ISBN 1-85233-165-8

D. RATLEDGE, Lancs, UK

Observing the Caldwell Objects

The objects listed in the Caldwell catalogue supplement Messier's famous catalogue of 110 non-stellar objects. Each object is conveniently laid out on a double-page spread (which can be photocopied for field use). There is a photographic image of every object and full technical data, including position (with the major Star Atlas chart numbers), NGC number, and a fold-out map showing the location of all the Caldwell objects in the sky.

2000/255 PP., 220 ILLUS./$34.95/SOFTCOVER/ISBN 1-85233-628-5

D.J. SHAYLER, West Midlands, UK

Disasters and Accidents in Manned Spaceflight

As the International Space Station takes shape, this fascinating book reports on the nature and history of the dangers connected with our manned ventures into space and anticipates future missions. It first describes the pioneering days of stratospheric balloon flights and rocket planes, continues with orbital and lunar programs such as Gemini, Apollo/Soyuz, the Space Shuttle, and Mir, and culminates with the ISS and likely planetary explorations.

PRAXIS **2000/500 PP., 174 ILLUS./SOFTCOVER/$34.95/ISBN 1-85233-225-5**
SPRINGER-PRAXIS SERIES IN ASTRONOMY AND SPACE SCIENCES

M. MAUNDER, Pyrford, and **P. MOORE,** Selsey, both, UK

Transit

When Planets Cross the Sun

Although the transit of planets across the Sun are rare, amateur astronomers can observe, record, and image other kinds of transit, which are much more frequent. *Transit* first tells the story of early scientific expeditions to observe transits and then explains how to observe transits of all sorts — even transits of aircraft as they fly between the observer and the Sun!

2000/164 PP., 35 ILLUS./SOFTCOVER/$39.95/ISBN 1-85233-621-8
PRACTICAL ASTRONOMY

Four Easy Ways to Order:

- **Call Toll Free: 800-SPRINGER;** 8:30 am to 5:30 pm ET or FAX: 201-348-4505; Please mention S2902 when ordering by phone.
- **Write** to Springer-Verlag New York, Inc., Dept. S2902, PO Box 2485, Secaucus, NJ 07096-2485.
- **E-mail** orders@springer-ny.com (outside North America, orders@springer.de).
- **Visit** your local scientific bookstore or urge your librarian to order.

Remember...your 30-day return privilege is always guaranteed!

10/00 Promotion #S2902

constellations, and Messier objects for any time and location entered. You can set a limiting magnitude, zoom in on any part of the sky, and see constellation lines. A search option locates stars and constellations. Click on any object to display name, magnitude, constellation, spectral type, distance, and right ascension and declination. Location Manager software (freeware) is required. This program has excellent graphical representation of the sky and features more consistent with a desktop planetarium, although it has a slower sky redraw than Planetarium.

Star Pilot Technologies; website, http://www.star-pilot.com; memory required, 46.6 KB; $29.95 (bundles including other astronomical software range to $59.95).

Messier (v1.23)

▶ For each Messier object, this program displays its name, type, home constellation, right ascension and declination, rise and set times, and azimuth and altitude. Table view allows you to quickly sort rise and set times. You can add your own observation notes, export them to Memo Pad, then view them on your desktop PC. Messier objects can also be sorted by name and magnitude.

Chris DiPierro, Star Pilot Technologies; website, http://www.star-pilot.com/messier/index.html; memory required, 44 KB; $9.95

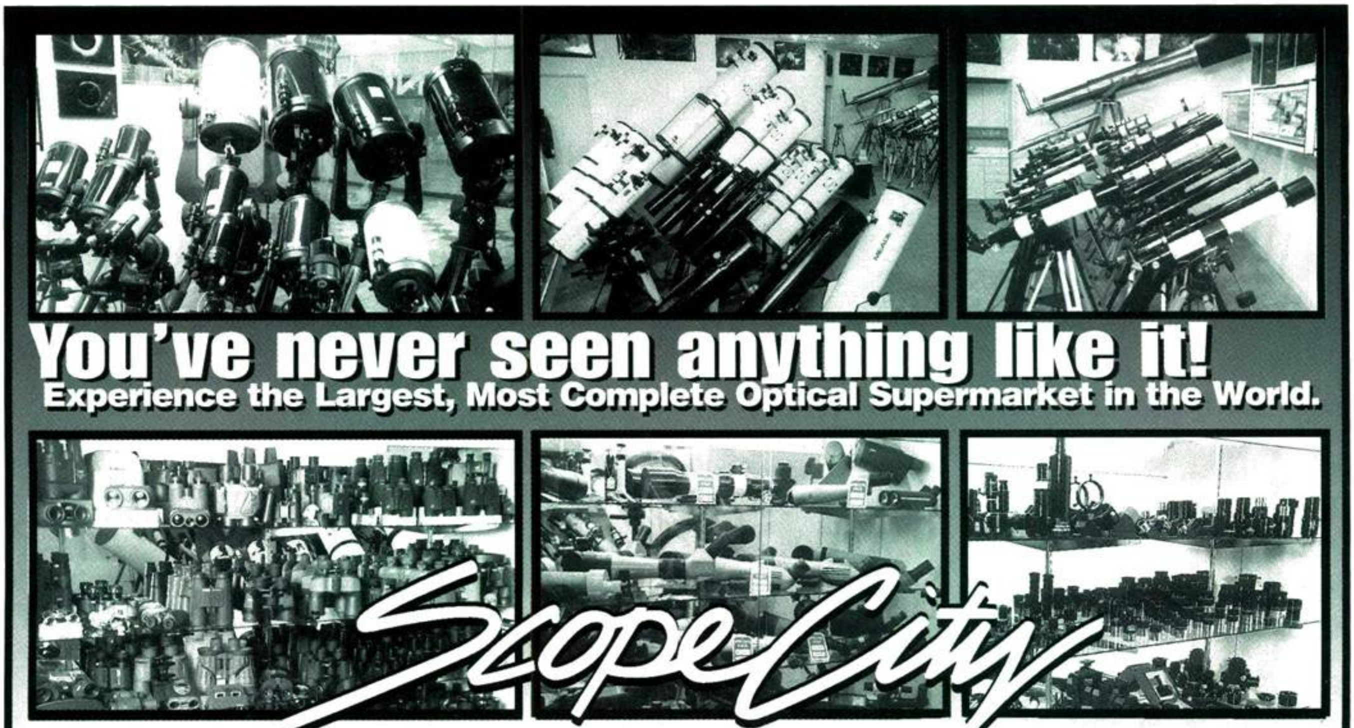
PocketSat

▶ Are satellites your bag? If so, this software is very handy. It computes the times when satellites will be visible at a given location over a user-defined time period. PocketSat also can be used to identify a satellite you just happened to see while looking up. It easily imports orbital data for an arbitrary number of satellites from a variety of publicly available sources and displays real-time sky plots with continually updated positions. PalmOS alarms can alert you when satellites are passing over. The program also lists detailed information for each satellite.

Palm Gear H.Q., 2500 E. Randoll Mill Road, Suite 117, Arlington, TX 76011; phone, (800) 741-9070 ($2 additional fee for telephone orders); website, http://www.emmgraphics.com/pilot/pocketsatinfo.html; memory required, 75 KB; $12.50.

J-Moons! (v3)

▶ This is an old favorite. This program graphically displays the positions of Jupiter's four Galilean satellites — Io,


You've never seen anything like it!
Experience the Largest, Most Complete Optical Supermarket in the World.
Scope City

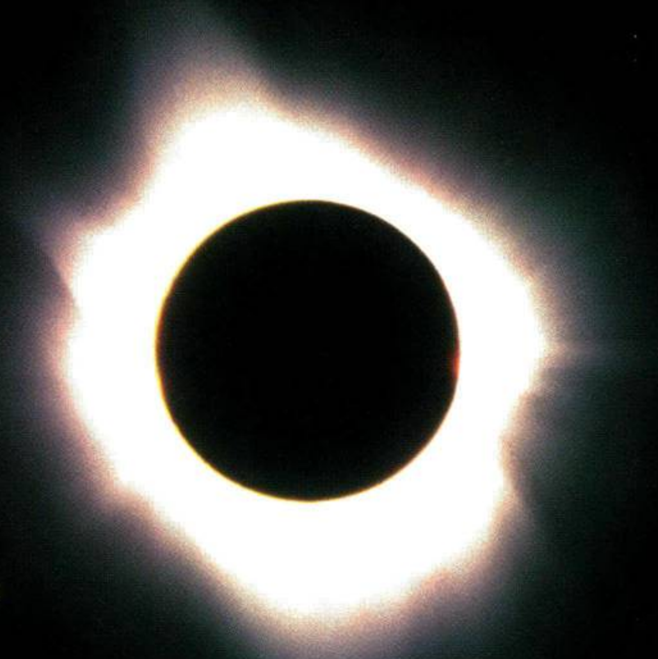
Scope City Locations / Showrooms
SIMI VALLEY, CA: 730 Easy Street, (805) 522-6646
SHERMAN OAKS, CA: 14324 Ventura Blvd., (818) 789-5805
COSTA MESA, CA: 3033 S. Bristol, (714) 957-6900
SAN DIEGO, CA: 4766 Clairemont Mesa Blvd., (858) 277-6686
LAS VEGAS, NV: 4825 W. Flamingo Rd., (702) 947-2673
SAN FRANCISCO, CA: 350 Bay Street, (415) 421-8800

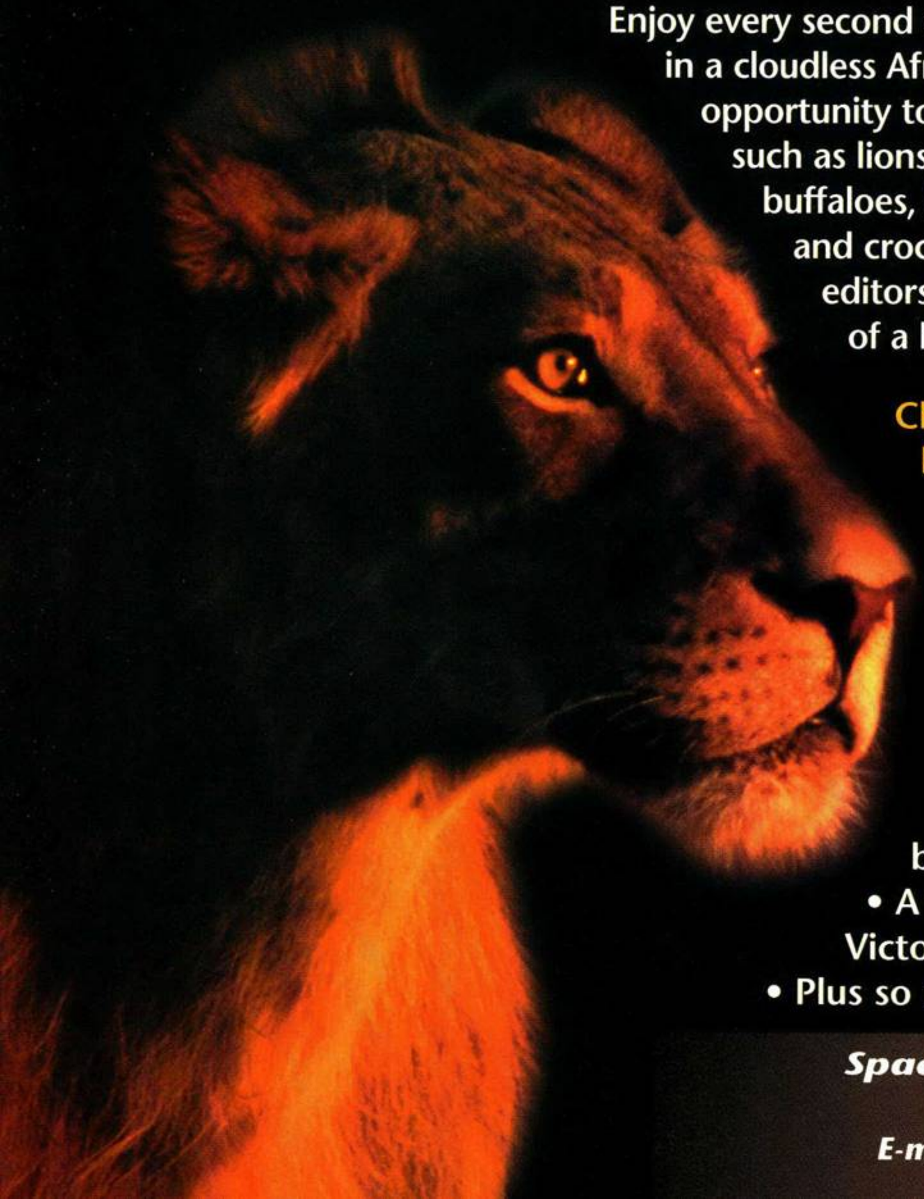
Save up to 45%
All Major Brands
at discount prices

Buy
Sell
Trade
Service

MAIN OFFICE: 730 Easy Street,
Simi Valley, CA 93065, (805) 522-6646

Scope City / Mail Order
P.O. Box 440, Simi Valley, CA 93062
TEL: (805) 522-6670
www.scopecity.com





See the splendors of the sky while on safari!

Solar eclipse 2001 Zimbabwe, AFRICA

June 11 - June 22, 2001 Or June 19 - June 30, 2001

Enjoy every second of the three-minute eclipse in a cloudless African sky. You'll have the opportunity to see exotic safari animals such as lions, elephants, cheetahs, cape buffaloes, hippopotamuses, impalas, and crocodiles! Join ***Astronomy*** editors for an amazing adventure of a lifetime!

Choose whichever tour best accommodates your personal schedule. Both magnificent excursions include:

- A fantastic view of the eclipse in a massive, clear sky.
- First-rate accommodations both in the city and on safari.
- A trip to the breathtaking Victoria Falls.
- Plus so much more!

Space is limited, so call today!
(800) 677-9412
E-mail at: gs@a1specialtytours.com

Europa, Ganymede, and Callisto — for whatever date and time the user specifies. It can be inverted for white on black display. It can also plot backward or forward one day at a time, or set user defined step-time.

MEW3 Software Development; website, http://www.mew3.com/palm/; memory required, 144 KB; $9.95.

MEW3 Software Development

Sol! II

▶ This software computes sunrise, sunset, length of daylight, beginning and end of civil, nautical, and astronomical twilight. It computes the length of day with twilight times for any location entered. Includes sun compass display, which automatically adjusts for Daylight Savings Time in 50 time zones.

MEW3 Software Development; website, http://www.mew3.com/palm/; memory required, 61 KB; $9.95.

Moon Info!

▶ Computes moon phase, rise and set times, and percent illumination. The program also gives dates and times of last lunation, as well as date and time of first quarter, full, and last quarter moons. Want to know the distance of Earth or the sun from the moon on a given day? The software will give it to you in statute miles, nautical miles, kilometers, or Earth radii.

MEW3 Software Development; website, http://www.mew3.com/palm/; $9.95.

Pizza-Pan Planisphere

▶ Hold the pepperoni, but add stars, constellations, and sprinkle on lots of fun astronomical facts for the beginner and you have the main ingredients for a 16-inch planisphere. It may be the largest planisphere commercially available. When the full moon hits your eye

ENCHANTED SKIES STAR PARTY
Sept. 28-Oct. 1, 2000

- Dark, dark skies
- Great chuck-wagon food
- Outstanding speakers
- Amateur Poster Session
- Vendor displays

For full details, see:
www.socorro-nm.com
click on "events."

or contact:
Chamber of Commerce
P.O. Box 743
Socorro, NM 87801
(505) 835-0424
chamber@socorro-nm.com

NEW MEXICO
LAND OF ENCHANTMENT

Socorro, New Mexico
80 mi. S. of Albuquerque

NEW
ROBO-DOME™

50" tall ROBO-DOME, with Thanh

- All-robotic observatory
- Big enough for a telescope, but not a person
- Fully Assembled
- All Fiberglass
- Very Affordable: $3200

Visit our Web Site!
We manufacture 6, 10 and 15 ft.
HOME-DOME & PRO-DOME
OBSERVATORIES.

Technical Innovations, Inc.
22500 Old Hundred Rd.
Barnesville, MD 20838
Ph: 301-972-8040
Fax: 301-349-2441
www.homedome.com

FREE Brochure

DISTINGUISHED
LEADERS
IN SCIENCE
LECTURES

Rebroadcast on
ResearchChannel
via satellite
Echostar Dish 500, Ch. 9400
via web and downlink

Tune in to these great lectures on ***cosmology, Mars, biodiversity, Europa*** and more!!

See
www.researchchannel.com
for details

The series is sponsored by the National Academies/National Research Council, NASA, U.S. Department of Energy, and The Institute for Genomic Research.

Check out our new online Learning Center!

telescope.com

Everything for the Amateur Astronomer—Delivered Direct

Come see what makes us click.

ORION
TELESCOPES & BINOCULARS

Our 25th Year!

Secure Online Ordering | Same-Day Shipping | FREE Technical Support | 30-Day Return Policy

Telescopes | Binoculars | Eyepieces | Barlows | Light Pollution Filters | Finder Scopes
Equatorial Mounts | Mirrors | Software | Star Atlases | Accessory Cases | Flashlights
Diagonals | Dew Shields | Camera Adapters | Motor Drives

Roger W. Tuthill, Inc
Your Astronomical Friend Asks:

Is your Schmidt Cassegrain Telescope sick, tired, dirty, in need of repair or expert collimation?

Call the experienced SCT doctors at
(908) 232-1786
or
Send a 9" x 12" SASE (with 4 stamps) for our **FREE** catalog.
See: **www.tuthillscopes.com**

Roger W. Tuthill, Inc.
Box 1086, Mountainside, NJ 07092

Search for Vendors of
Astronomical Equipment
on the
PRODUCT INFO PAGE at:
www.astronomy.com

FOR THE LOWEST PRICES & BEST SERVICES TO ORDER CALL TOLL FREE
1-888-4ASTRONOMY
(1-888-427-8766)
Phone Orders: Mon through Sat. 9-6 Pacific Standard Times

WOODLAND HILLS Camera
Telescopes • Electronics
5348 Topanga Canyon Blvd., Woodland Hills, CA 91364
TEL: 818-347-2270 • FAX: 818-992-4486

Stocking Dealer for: CELESTRON • MEADE • TELE VUE • LOSMANDY • PENTAX • JMI

FULL LINE MEADE STOCKING DEALER

TELE VUE

Plossl-50°
8-11, or 15 .... $82
20 or 25mm $95
Panoptic-68°
15mm $210
19mm $240
Nagler-82°
4.8mm $175
7mm $220
Nagler type 4 12mm $370
Nagler type 5 31mm $595

SCOPESAVER

LX200 Scope Saver 11.5"x 20" $98
- A must for 10" LX owner
- Fits 7"-12" Meade scopes
- Hold 12 eyepieces! Holds keypad Securely

LOSMANDY

G11- Mount with dual access drive.
$1,895.00
GM-8 mount, dual access drive.
$1,399.00

JMI

Precision Fault-Free Focuser
NGFS $269.00
Moto Focuser Non-vignetting adapter $45.00
Wheeley Bars
Universal 8" or 10" SCT $159.95
12" LX200 .... $199.95
Custom-Made $250.00

PENTAX

65° Field
5.2 or 7mm $279
10.5 or 14mm $269
21mm $269
28mm $259

MEADE

Meade
7", 8", 10" & 12"
Dobs, Equatorials, SCT's & Refractors in stock.
We have the complete line of **Meade** CCD cameras in stock.
GoTo Telescope

Meade ETX 90R/A
$469.00
Trade in year old ETX to the new 90 or 125EC
ETX 90 R/A used $369.00
Meade DS 90 EC
Too low to print .... Call
Complete line of DS Telescopes in stock.
Full line of accessories in stock.

CELESTRON

C8 Deluxe .... Call
CG11 .... Call
Ultima 2000 .... Call
G3 & G5 (With Motor) .. Call
CR150 Refractor .... In Stock

CELESTRON 1 1/4" EYEPIECES
ULTIMA EYEPIECES
5mm, 1 1/4" $69.95
7.5 .... $69.95
12.5mm, 1 1/4" $69.95
18mm, 24mm, 1 1/4" $79.95
30mm, 1 1/4" $84.95
35mm, 1 1/4" $99.95
42mm 1 1/4" $99.95
Ultima Barlow Short tube Version $69.00
PLOSSL EYEPIECES
6.3, 7.5, 12.5, 10, 17, 1 1/4" $39.95
32, 40mm, 1 1/4" $59.00

Celestron C90 Rubber Armored 1 1/4" Eyepiece..... $355

The New NexStar 8 GoTo Telescopes by Celestron In stock........ $1899
NexStar 8

TELRAD FINDER $39.95
Thousand Oaks Solar Filters (Mounted Glass)
8" Solar Filter .... Call
10" Solar Filter .... Call
12" Solar Filter .... Call

ASC Graphics 8-16-99

FOR THE LOWEST PRICES & BEST SERVICES TO ORDER CALL TOLL FREE
1-888-4ASTRONOMY
(1-888-427-8766)
Phone Orders: Mon through Sat. 9-6 Pacific Standard Times

LET OUR FACTORY TRAINED EXPERT HELP YOU WITH YOUR TELESCOPES NEED CALL US
818-347-2270

MasterCard VISA AMERICAN EXPRESS Card DISCOVER

WE SHIP ANYWHERE • VISIT OUR WEB SITE WWW.TELESCOPES.NET

like a big pizza pie, the *David H. Levy Guide to the Stars* planisphere also provides handy information about Earth's satellite on the back of the plastic field guide. The reverse side also has a meteor-showers table, a list of observing hints, and even a timeline of astronomy's greatest discoveries and events (including — why not? — the July 1994 crash of Comet Shoemaker-Levy 9 into Jupiter).

The planisphere, which has black stars on a white background, is intended for use at all latitudes in the United States. It also has its own website where observers can get more information.

Ken Press, 4001 N. Paseo de los Rancheros, Tucson, AZ 85745; website, http://www.whatsouttonight.com; phone, (520) 743-3200; $19.95.

The Webweaver Picks

If the Leonid meteors interest you, try these websites for images, background on the annual shower, and news about comet 55P/Temple-Tuttle, the source of the shower:

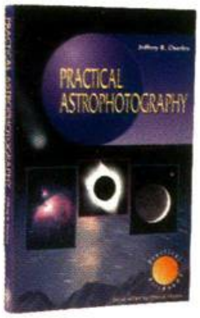
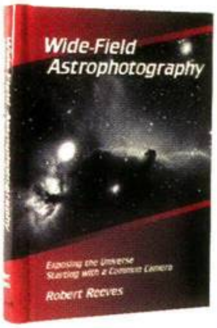
The 1999 Leonids
http://www.imo.net/leo99/leo99index.html
http://www.eso.org/outreach/info-events/leonids99/

Lowell Observatory's Comet 55P/Tempel-Tuttle and Leonid Meteor Shower page
http://www.lowell.edu/users/farnham/tt/index.html

NASA's Leonid Multi-Instrument Aircraft Campaign
http://leonid.arc.nasa.gov/index.html

Wilhelm Tempel's Biography
http://leo.astronomy.cz/tempel/tempel.html

A BOOKS

Practical Astrophotography

Jeffrey R. Charles, 301 pages, Springer-Verlag, New York, 2000; ISBN 1-85233-023-6; paperback, $34.95.

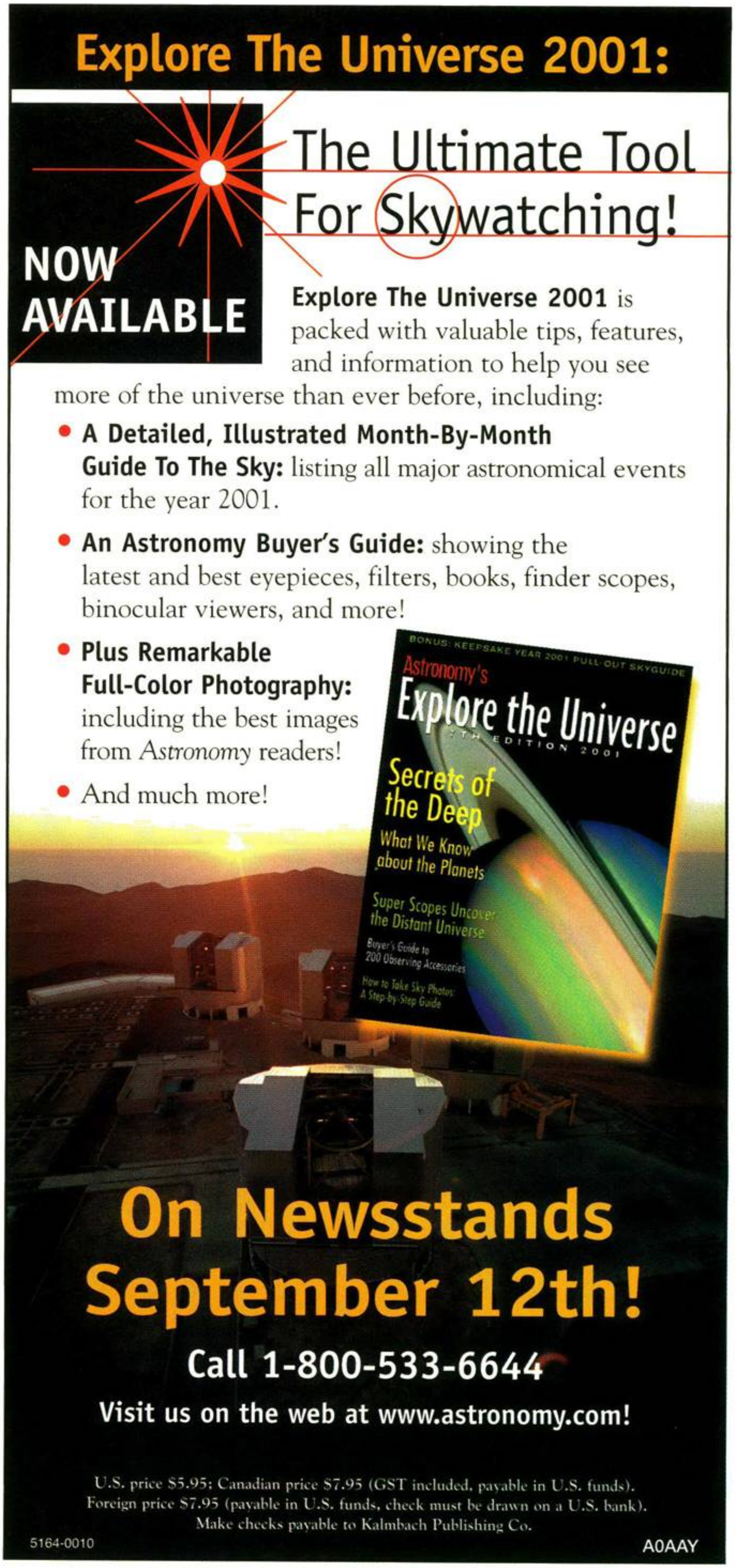
Wide-Field Astrophotography

Robert Reeves, 534 pages, Willmann-Bell, Richmond, Va., 2000; ISBN 0-943396-65-4; hardcover, $29.95.

▶ Whether you are an experienced astrophotographer or just getting started, these two new books serve up helpful advice to help you capture the glory of celestial objects. The fifteenth book in Springer-Verlag's Practical Astronomy series (edited by venerable British astronomer Patrick Moore), *Practical Astrophotography* starts off with camera, film, and telescope basics. The book also covers accessories, travel, clock drives, explanations of how to photograph various types of objects and events, and tips on developing your film. A section near the end discusses CCD imaging and electronic-image processing.

As the title suggests, *Wide-Field Astrophotography* concentrates on advice for taking sweeping images of large swaths of sky. This book also starts with the basics and then cranks up the sophistication scale. Later chapters deal with issues such as film hypersensitization, darkroom techniques, minimizing the effects of dew, and digital imaging and processing. The final chapter explores the history and legacy of astrophotography by professional astronomers.

Both books were written by experienced astrophotographers and come with tables, illustrations, and black-and-white astrophotos.



Explore The Universe 2001:

The Ultimate Tool For Skywatching!

NOW AVAILABLE

Explore The Universe 2001 is packed with valuable tips, features, and information to help you see more of the universe than ever before, including:

- **A Detailed, Illustrated Month-By-Month Guide To The Sky:** listing all major astronomical events for the year 2001.
- **An Astronomy Buyer's Guide:** showing the latest and best eyepieces, filters, books, finder scopes, binocular viewers, and more!
- **Plus Remarkable Full-Color Photography:** including the best images from *Astronomy* readers!
- And much more!

On Newsstands September 12th!

Call 1-800-533-6644

Visit us on the web at www.astronomy.com!

U.S. price $5.95; Canadian price $7.95 (GST included, payable in U.S. funds).
Foreign price $7.95 (payable in U.S. funds, check must be drawn on a U.S. bank).
Make checks payable to Kalmbach Publishing Co.

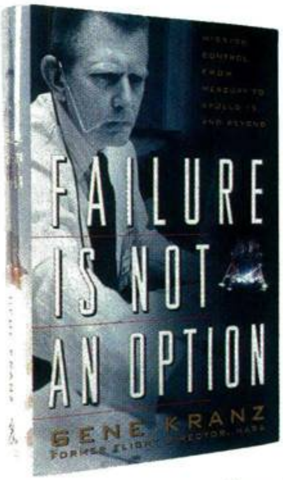
5164-0010

A0AAY

BONUS: KEEPSAKE YEAR 2001 PULL-OUT SKYGUIDE
Astronomy's
Explore the Universe
7TH EDITION 2001
Secrets of the Deep
What We Know about the Planets
Super Scopes Uncover the Distant Universe
Buyer's Guide to 200 Observing Accessories
How to Take Sky Photos: A Step-by-Step Guide

Failure Is Not an Option

Gene Kranz, 415 pages, Simon & Schuster, New York, 2000; ISBN 0-7432-0079-9; hardcover, $26.



"An examination of the current technical and industrial development demonstrates the high probability that the moon will shortly be conquered by man. The base will probably be established in five years and completed in ten." So wrote Gene Kranz in his 1950 high school thesis.

How prophetic that this boy became one of the men who helped us land on the moon. Reading *Failure Is Not an Option* by Gene Kranz, a former Air Force pilot and flight director from NASA's pioneering days, is comparable to watching *Titanic*: You already know the ending.

In this case, though, predictability compels rather than deters the reader, especially those old enough to remember the heady days of America's entry into space.

With Kranz's help (and to quote those old educational movies narrated by Walter Cronkite), "You are there." Through Kranz's prose, you almost smell the stale cigarette smoke and nervous sweat as Mission Control crews guide successive groups of astronauts — from the Mercury program to the last moon landings. The men behind the astronauts were the best of the best. They matured on the job in a learn-by-doing process that also drew in the American public.

After all, these were *our* astronauts, deserving every bit of adoration we gave them as the space program captivated America. Black-and-white TV sets popped up at work. Classes stopped as students viewed every launch. Most Americans followed the early missions so closely that astronaut's names peppered conversations as easily as gasoline prices do today. Spiritually, we were all aboard as one rocket after another soared into space. But we seldom gave thought or credit to those behind the scenes. We saw Mission Control as an anonymous and invariably male team decked out in crew cuts and ties — and then only in short glimpses cheering new successes or explaining disasters.

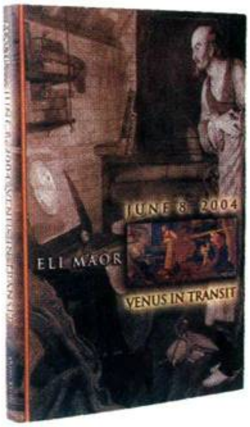
Kranz enlarges that view by introducing the dedicated personalities responsible for our golden age in space. For the most part, Kranz's engaging first-person account reads like a diary, exploring the highs and lows as well as the frustrations of dealing with technology that would look archaic today. Don't be surprised if you experience a flood of emotions along with Kranz: You'll worry about Scott Carpenter tumbling through his Mercury mission, choke up once again over the tragic Apollo 1 fire, and burst with pride as Neil Armstrong takes his famous leap for mankind. Likewise, you'll feel your heart racing as Kranz and his team work frantically to save the Apollo 13 crew.

Kranz tells it all. He makes no excuses for mistakes and no apologies for sometimes trusting dumb luck and hunches. Each accomplishment becomes even more amazing when you realize that this all happened three decades ago. His narrative slows only when he occasionally overuses acronyms and abbreviations. (This is hardly avoidable. NASA is, after all, a government agency prone to technobabble.)

Ironically, the title of Kranz's book is the opposite of recent popular perceptions of NASA's space program. Especially poignant is the epilogue, which details what he believes are the four essential elements for America's future in space. *Failure Is Not an Option* ultimately renews hope that humans can and will do it all again, with even more spectacular results.
— *Carol Ryback, associate editor*

June 8, 2004: Venus in Transit

Eli Maor, 186 pages, Princeton University Press, Princeton, 2000; ISBN 0-691-04874-6; hardcover, $22.95.



Brimming with historical anecdote and up-to-date information, this book provides much more than a simple introduction to two of the most anticipated celestial events of the 21st century: the 2004 and 2012 transits of Venus across the face of the sun. *June 8, 2004* not only alerts readers to the upcoming transits, it chronicles the fervor, triumph, and folly that accompanied the last five transits of Venus witnessed by Western civilization from 1639 to 1882.

Eli Maor, a mathematician at Loyola University in Chicago, adeptly outlines pivotal moments in the development of our understanding of the solar system. He invites the reader into the room where Johannes Kepler predicted the 1631 transit. He also leads the reader to the Indian Ocean island of Mauritius, where French astronomer Guillaume Le Gentil waited eight years to view the 1769 transit. (He missed the 1761 transit because monsoons blew his ship off course.)

Maor makes his story accessible to readers with varied levels of astronomical knowledge. He enhances his text with maps, diagrams, and illustrations. And those readers who prefer to supplement their reading with more mathematical or historical information won't be disappointed. Appendices, endnotes, and sidebars accompany the main text. This book will please the history aficionado and the most ardent amateur astronomer. — *William Schomaker, University of Wisconsin*

PRODUCT INFO

Suppliers should send announcements and color photographs to Star Stuff, P.O. Box 1612, Waukesha, WI 53187, or e-mail starstuff@astronomy.com. *Astronomy* assumes no responsibility for the product information supplied by manufacturers. Prices are retail and subject to change without notice. Check *Astronomy*'s website for further product updates — http://www.astronomy.com

Astronomy's

Marketplace

Welcome to the MARKETPLACE section in ASTRONOMY Magazine. These pages are specifically designed to be an affordable and highly effective way for you to market astronomy-related products or services. Call Michael Ellis at 888-558-1544, ext. 636 to place your advertising message here.

Andromeda Astronomy Mall
A galaxy full of online vendors
CLICK HERE
www.M31MALL.com

KITES, FLAGS & WINDSOCKS
Have fun anywhere the wind blows.
Call for our FREE 80-page catalog today!
Into The Wind 1408-A Pearl St., Boulder, CO 80302
800-541-0314 www.intothewind.com

ASTROLA™ Mirrors

Build the telescope of your dreams.

Astrola 8-inch f/6 mirror set	$ 950*
Astrola 10-inch f/6 mirror set	$ 1195*
Astrola 12.5-inch f/6 mirror set	$ 1495*

Hardin Optical Company
www.hardin-optical.com or call toll free: 1-877-447-4847
* F.O.B. Bandon, OR

Starsplitter Telescopes

Quality Focused on the Customer!

Starsplitter II
15"- 40"
Compacts
8"-15"

We offer the largest selection of Newtonian telescopes on the market today!

Please send $2.00 for a catalog.
Online catalog at www.starsplitter.com

Starsplitter Tube
6"-10"
APO - Eater
6" f/10 & 8" f/8

Starsplitter Telescopes
3228 Rikkard Drive
Thousand Oaks, CA 91362
805-492-0489 Phone & Fax
www.starsplitter.com

TEC

MAKs, APOs and other precision optics for sophisticated observers.

Telescope Engineering Company
15730 W 6th Av. Golden, CO 80401
E-mail tec@telescopengineering.com
Ph. 303 273 9322 • Fax 303 273 9322

www.telescopengineering.com

SCOPETRONIX

QUALITY ASTRONOMY PRODUCTS
PHONE/FAX (941)945-6763

UNIQUE AND USEFUL PRODUCTS FOR YOUR:
ETX - NEXSTAR - LX10/50/200

LX50 "Dec Fix Kit" Improves Performance

Low Cost-High Quality Plossl Eyepieces

Joystick for LX200/Magellan II

ETX & NexStar Astro 300 Tripods

Celestar 8 & LX10 Astro 600 Tripod

Universal Digital Camera Adapter

ETX & NexStar Piggyback Mounts

WE ACCEPT:
VISA
MasterCard
AMERICAN EXPRESS Cards

Flexi-Focus™ for the ETX

ETX & NexStar Eyepiece Racks

The "Dew Clip" Dew Heaters

The "Dew Coil" Eyepiece Heaters

ETX & NexStar Photo Tripod Adapters

LX10/50 Deluxe Latitude Adjusters

Tripod Leg Clamps Fits ETX & Others

ScopeTronix Products are also available at these fine Retailers:
Sky Works - Tucson, AZ
Mike's Camera, Inc. - Boulder, CO
Shutan Camera & Video - Chicago, IL
Astronomy World UK Ltd.- Hampshire, England
Oceanside Photo and Telescope (OPT) - Oceanside, CA

Dealer Inquiries Invited!

WE ARE A CELESTRON SHOWCASE DEALER

WE STOCK CELESTRON, SCOPETRONIX, JMB, RIGEL, LENSPEN, STARBOUND, ASTELE/LOMO AND MORE!
24 HOUR ONLINE SHOPPING & SECURE ORDERING
WWW.SCOPETRONIX.COM

PARFOCAL BRANDON® OCULARS

Effective focal lengths: 8, 12, 16, 24 and 32mm

STEP UP TO BRANDON!

#1 for Contrast

VERNONSCOPE & company
Division of
Gould Precision Optics Inc.

151 Court Street
Binghamton, NY 13901
Toll Free in US
888.303.3526
607.722.5697
607.722.7939
www.vernonscope.com

Astronomy's Marketplace

8" f/6
10" f/5
12.5" f/5

Take It For A Spin!

Mag1 Instruments Portaball
Quick Set-up • Rotatable Tube
Exceptional Optics

SEE It Spin Online!

mag1instruments.com
262-785-0926

The Original And The Best! SEE US ON THE WEB!

OBSESSED WITH THE BEST?

We are. Nothing else comes close to an Obsession.

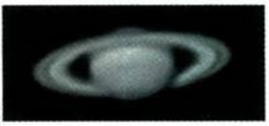
Apertures from 15-30 inches.

Get Obsessed now. Brochure and a 2hr. video, just $2.

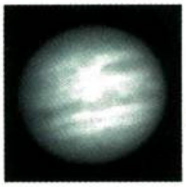
PO Box 804a
Lake Mills, WI 53551
(920) 648-2328 • Fax also

OBSESSION TELESCOPES™
www.obsessiontelescopes.com

Entry level CCD imaging
Includes camera, software and everything needed for prime focus & eyepiece projection in 24 bit color
407-259-0332



SAC
P.O. Box 360982
Melbourne, Fl. 32936
wsnyder@gateway.net



SACII
$129
SACIV
$224

http://members.xoom.com/sonfest/

TeleDome

Finally, a truly portable observatory!
Sets up in less than one minute!
Well made - Durable - Reliable - Convenient
Easy set-up/take down - Compact - 20 lbs.
Fits in car - Perfect for astrophotography
32" observing slot - 7.5'W x 6'H (6.5'H avail)
Price: $398.00 + S&H

Tele/Wrap Dew Cap

Beautiful dew cap for Meade ETX-90/125
Real professional astrophoto of M-45 or M-42
Black velvet felt lining - Thin lightweight
Slides forward in use and back for storage
$24.95 (ETX-90) $39.95 (ETX-125)

Clear Night Products
P.O. Box 721480, Berkley, MI 48072 (248) 547-2315
http://home.earthlink.net/~barrycnp

We Buy

Telescopes, Parts and Accessories
Free Estimates

Hands on Optics

P.O. Box 412 Damascus MD 20872
www.handsonoptics.com
Or ask for our free price list.
301-482-0000

SKYWATCHER'S INN

THE ARIZONA ASTRONOMY AND NATURE RETREAT

BED AND BREAKFAST at the
VEGA-BRAY OBSERVATORY
New, modern, and comfortable lodging.
Many **TELESCOPES** from 6 to 20 inches,
computer slewing and **CCD** imaging.
Science museum and planetarium.
DARK SKIES AND SPARKLING DAYS.
47 miles east of Tucson, 28 miles from Tombstone.
Close to many astronomical observatories, historical and natural attractions including Kartchner Caverns.
By appointment only: Tel/fax: (520) 615-3886
c/o 5655 N. Via Umbrosa, Tucson, Arizona 85750
http://www.communiverse.com/skywatcher
E-mail address: vegasky@azstarnet.com

---

new. mexico skies

GUEST OBSERVATORY

☆ *Spectacular Skies*
DARK Steady Mag 7+ skies
Great Seeing - 7300' elevation
Near: Apache Point & Sunspot

☆ *Great Equipment*
16"/12" Meade LX 200
14" Celestron / Paramount
7" Astro Physics APO
30"/25"/15" BIG Dobs
Full line SBIG CCD cameras

☆ *Modern Accommodations*
Full size kitchens / 3-2-1 bedrooms

Mike and Lynn Rice, Astronomers
www.nmskies.com
info@nmskies.com
Phone: 505-687-2429/Fax: 505-687-3710
P. O. Box 559, Cloudcroft NM 88317

METEORITES

Michael I. Casper, Meteorites, Inc.
Post Office Drawer J
Ithaca, New York 14851 U.S.A.
Phone: 607-257-5349 Fax 607-266-7904
e-mail: casper@meteorites.com
http://www.meteorites.com

PEGASUS OPTICS

Precision-Made Parabolic Mirrors
18" - 25" Diameter

•2" Thickness Pyrex (16 - 25") Precision-Annealed
• Unconditional, Written Lifetime Warranty
•Guaranteed to Surpass Diffraction-Limited Criteria
•Quantitative Certification with Surface/Wavefront Graphs
•3.1 - 4.0" 98% diagonal mirrors

Web site at http://www.icstars.com/pegasus
e-mail: hallj@admin.hillconet.com

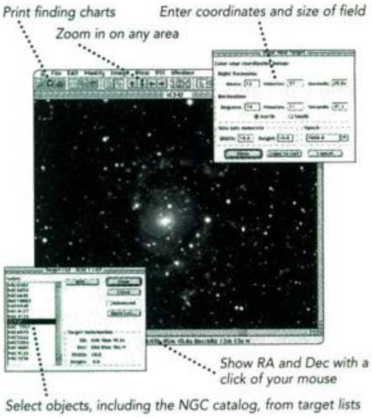
"You'll see the difference" -John Hall, Owner

TEL/FAX: (830) 563-2578
P. O. Box 1389
Bracketville, TX 78832

RealSky CD

Use with TheSky, Guide 6.0, MegaStar, SkyMap Pro and Starry Night Pro

"A dream come true."
– *Dennis di Cicco, Sky & Telescope*


Print finding charts
Enter coordinates and size of field
Zoom in on any area
Show RA and Dec with a click of your mouse
Select objects, including the NGC catalog, from target lists

RealSky CD is a must-have resource for the serious astronomy enthusiast. Angular resolution of 1.7 arcseconds • Unprecedented level of telescopic detail • Stars to 19th magnitude. ***North:*** to -15° on 8 CD-ROMs. ***South:*** to the equator on 10 CD-ROMs.
For Windows '95/NT, PowerMac.

New Low Price! Just $200 each or $375 for both!

To order, call 800/335-2624 (415/337-2126 outside U.S.)
Email: catalog@aspsky.org Order Online: **www.aspsky.org**

OPTICAL GUIDANCE SYSTEMS
Custom-Made Ritchey – Chretien, Classical Cassegrain and Newtonian telescopes 10-32 inches.
World's #1 selling line of Ritchey - Chretien Optics
OpticalGuidanceSystems.com
2450 Huntingdon Pike, Huntingdon Valley, PA 19006
Ph/Fax: (215) 947-5571

ECLIPSE SHADES™
Safe Solar Viewers
Custom Imprinting Available!

ECLIPSE SHADES™
SAFE FOR DIRECT SOLAR VIEWING

Eclipse Shades™ provide the ultimate in protection from harmful Solar Radiation. Lenses made of Optical Grade, Neutral Density 5 Mylar, filter out 100% of Ultra-Violet, 100% of Infra-Red, and 99.999% of Visible Light.

Quality Paper Eyewear & Specialty Optics
Rainbow Symphony, Inc.
6860 Canby Ave. #120, Reseda, CA 91335
1-800-821-5122 FAX (818) 708-8470
E-Mail: eclipse@rainbowsymphony.com
www.rainbowsymphony.com/soleclipse.html

Howie Glatter's Laser Collimators announces a new accessory supplied with each collimator : a Small Aperture Stop

Reduces brightness and provides a smaller, circular, diffraction-limited beam for greater collimating precision.

The bad news . . . a corresponding $10 price increase on all collimators 12\01\00

The good news . . . the Stop will be included with all collimators at current prices until the new ones take effect

Howie Glatter 3850 Sedgwick Ave. Bronx, N.Y. 10463
e-mail : howieglatter@mindspring.com
www.collimator.com Tel/Fax 718 796 3203

EUROPE'S PREMIER WEBSITE
http://www.scsastro.co.uk
SCS ASTRO

METEORITES!
Irons. Stones. Stony-irons. Tektites.
Quality display and study specimens.
Space jewelry, books, slides.
Authenticity guaranteed.
Color Catalog $2.
Bethany Sciences
P.O. Box 3726-A
New Haven, CT 06525
CATCH A FALLING STAR!
(203)393-3395

Buy a Star ★ Name a Star
On the exclusive
MSAS Star Atlas
Soon to be placed in the newly-opened MSAS Astronomy Village
Receive a certificate of record and more.
Mtn. Skies Astronomical Society
Box 1169 - LkArwhd, CA. 92352
Free brochure.
Starting at only $25.00!
VISA/MC accepted
(909) 336-1699
www.mountain-skies.org

Bargain Books
America's *biggest* catalog selection
- **Save up to 80%** on recent publishers' overstocks. Save on current books and best sellers, too!
- **Astronomy**, Science, Computers, Photography, Biography, Travel—over 60 subject areas.

Free Catalog
1-800-677-3483
Edward R. Hamilton, *Bookseller*
6297 Oak, Falls Village CT 06031-5005
erhbooks.com/bgg

Specialists in Video and CCD imaging
www.astrovid.com

Astrovid 2000
· Easy to use Real-time Video System
· No computer required · Perfect for schools and planetariums · LCD Systems available

CCD Imaging Accessories
· Unique combo flip mirror filter holder
· Large format motorized filter wheel
· Tri-color dichroic and CMY filter sets

Starlight Xpress
· Innovative compact design · Low noise
· High blue sensitivity · Models include unique "one-shot color" CCD

Call us toll free at: 1.888.799.0107
or visit our website at: www.astrovid.com for additional information and for many more unique products.

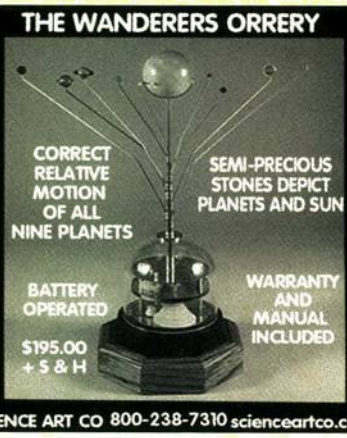
Adirondack Video Astronomy
26 Graves Street, Glens Falls, NY 12801 USA
Info line +1 518 812 0025 Fax +1 518 745 4114
www.astrovid.com
AVA adirondackVIDEOastronomy

PRODUCT OF THE MONTH
VISIT OUR WEB SITE
SCHMIDT-CRAYFORD FOCUSERS
W/DC SERVO MOTOR CONTROL
& ANALOG OR DIGITAL READ-OUTS

REMOTE LED DISPLAY BOX
4.7852
OUT
IN

OPTIONAL-$495 SCF4-$895
VISA/MC
SCF3-$795 CATALOG $5 SCF5-$1395
VAN SLYKE ENGINEERING
12815 PORCUPINE LN, COLORADO SPRINGS, CO 80908
VOICE/FAX 1-719-495-3828, E-MAIL: BFO@OBSERVATORY.ORG
WEB SITE: WWW.OBSERVATORY.ORG/VSENGR.HTM

THE WANDERERS ORRERY


CORRECT RELATIVE MOTION OF ALL NINE PLANETS
SEMI-PRECIOUS STONES DEPICT PLANETS AND SUN
BATTERY OPERATED
WARRANTY AND MANUAL INCLUDED
$195.00 + S & H

SCIENCE ART CO 800-238-7310 scienceartco.com

VIEW THE "OLD UNIVERSE" IN A NEW LIGHT!

The new ITE "COLOR-EYE" Color Slow-Scan CCD Video Astro-Camera fits any telescope or telephoto lens system. Observe the sun (proper filter required), moon, comets, and planets in real time and in vibrant color at a cost equal to or less than most B&W cameras. Camera is no larger than most 2" eyepieces and is fully self contained (auto shutter, gain and balance). No computer required; connect directly to your VCR, Camcorder, HI-RES monitor or TV. Add an Auto Capture Card to your laptop and capture single frame color images equal to those generated by high-end CCD cameras costing much, much more. Transforms any common telescope into a fantastic group astronomy instrument.

ITE "COLOR-EYE" CCD VIDEO ASTRO-CAMERA....... $ 595 + 15 s&h
MARGI "Capture-to-Go"™ Video Capture Card .... $ 295 + 10 s&h
(VISA**MASTERCARD**AMEX**DISCOVER ACCEPTED)

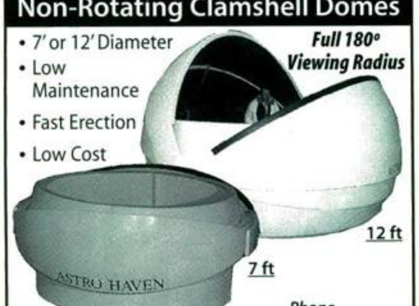
ITE/INTERNET TELESCOPE EXCHANGE
3555 Singing Pines Rd., Darby, MT 59829 USA
Ph.: (406) 821-1980 • Email: cescoweb@AOL.com
Website: www.burnettweb.com/ite

Astronomy's
Marketplace

ASTRO HAVEN
Non-Rotating Clamshell Domes

- 7' or 12' Diameter
- Low Maintenance
- Fast Erection
- Low Cost

Full 180° Viewing Radius



#113 5778 Production Way, Langley,
British Columbia, Canada V3A 4N4
www.sales@astrohaven.com

Phone
(604) 539-2208
Fax
(604) 539-2209

TRACKING for DOBS

*** High power observing and group viewing**
***Astro-imaging with NO field rotation**
call write or e-mail for free brochure
EQUATORIAL PLATFORMS 530-274-9113
15736 McQuiston Lane **Grass Valley CA 95945**
tomosy@nccn.net **www.Astronomy-Mall.com**

SCOPE SAVER
BB200 OBSERVING TABLE

The **BB200** is the heart of the ***Scopesaver*** observation station. It fits all ***Meade*** Telescopes that use a standard tripod, including LX200 (7-12"), LX50 (7-10"), 2045D, 2080/2100 (8-10"), all Meade refractors, and some **Celestrons.** The 12x20x1/4" aluminum table is black anodized. Additional accessories available. Amex-M/C-Visa. **Beigle/Bryant Engineering**, P.O. Box 5247 • Pine Mountain Club, CA 93222 ***800 330-8339*** Phone/Fax: (661) 242-5804.

New ASTROLA™ Mirrors

8, 10, and 12.5-inch diameters. F/6 systems with diagonal.

Call toll free: 1-877-447-4847
www.hardin-optical.com

Hardin Optical Co.
1450 Oregon Ave., Bandon, OR 97411

SINGLES IN SCIENCE

and others interested in science/nature are meeting through *Science Connection*

800-667-5179
www.sciconnect.com/

CCD IMAGING EQUIPMENT
MORE THAN 6 YEARS EXPERIENCE!

ACCU-FOCUS™ FOR SHARP COLLIMATED IMAGING!

SBIG CAMERAS
ADAPTIVE OPTICS
MEADE CAMERAS
CELESTRON CAMERAS
ADVANCED APOGEE
CCD DEALER

M1 IMAGED WITH SBIG ST8, AO-07, 12.5" R-C TELESCOPE, BYERS MOUNT & ACCU-FOCUS™ © R.BELL, 1998

WHAT IN THE WORLD

PHONE ORDERS TOLL FREE
(888) 942-8967
ON LINE CATALOG
www.whatintheworld.com
P.O. Box 1767 28200 Hwy. 189 #E200
Lake Arrowhead, CA 92352
PH: (909) 337-5080 • FX: (909) 336-9708

NEW AUTHORS
PUBLISH YOUR WORK
ALL SUBJECTS CONSIDERED
WRITE, OR SEND YOUR MANUSCRIPT TO:
MINERVA PUBLISHING CO.
1001 BRICKELL BAY DR., # 2310, MIAMI, FL 33131

Explore the Heavens & Earth with us in Northern Arizona

- **Largest telescopes (up to 36") for your use in the best dark skies**
- **Days filled with guided geologic tours and more**
- **Expert instruction/ assistance**
- **Comfortable accommodations**
- **Ideal for novice and expert alike**

ASTRONOMICAL ADVENTURES
educational and recreational adventure vacations

2532 North Fourth Street Suite 200
Flagstaff, Arizona 86004
(602) 485-4367
www.AstronomicalAdventures.com

Africa
June 21, 2001
Zimbabwe
Eclipse

INNOVATIONS IN TRAVEL INC.
1-800-733-3361
E-mail: innovationsintravel@msn.com
Website: innovationsintravel.com

AMATEUR ASTRONOMERS! WANT TO START YOUR OWN BUSINESS?

Consider investing in a STARLAB Portable Planetarium System (starting at $10,500) and share your astronomy enthusiasm with schools, scouting groups, parents and more! Great earning potential!

LEARNING TECHNOLOGIES, INC.
40 CAMERON AVENUE, SOMERVILLE, MA 02144 USA
PH: 800-537-8703 OR 617-628-1459 · FAX: 617-628-8606
E-MAIL: STARLAB@STARLAB.COM · WWW.STARLAB.COM

ASTRO-PHYSICS

High-quality instruments for discriminating observers and astrophotographers

Refractors- 105,130,155 mm dia.
Go-To German Equatorials
Visual and Photographic Accessories

155 Starfire EDFS with 2.7" Focuser, 900GTO German Equatorial Accessories

11250 Forest Hills Rd.
Rockford, IL 61115 USA
Ph: 815-282-1513, Fax: 815-282-9847
www.astro-physics.com

TELESCOPE KITS, LENSES, ACHROMATS MIRRORS, MIRROR BLANKS, ALUMINUM COATINGS & ACCESSORIES
BUY DIRECT ★ DO IT YOURSELF
Stock & Custom mirrors and molded mirror blanks, diagonals, parts made from Pyrex, optical glasses, fused silica, quartz and other low expansion ceramic materials. Telescope accessories, do-it-yourself books.
Write, call, fax or e-mail for catalog
NEWPORT GLASS WORKS, LTD.
P.O. Box 127
Stanton, CA 90680
PH: (714) 484-8100
FAX: (714) 484-8181
E-mail: ngw@netcom.com
Web: http://www.newportglass.com

STAR TEK
FINE ASTRONOMY PRODUCTS
See our '3-in-1' tray and other new products at
www.startekind.com
Toll Free: 888-416-9480

ECLIPSE 2001
ADVENTURES

ALL NEW Explorer Series
Botswana • Zambia • South Africa

Call for FREE brochure: 800 830-1998
Journeys for Inquisitive Minds
TravelQuest
INTERNATIONAL
570 Skyview Dr., Prescott, Arizona 86303
Visit our Website: www.tq-international.com

CELESTRON®
Now Carrying
MEADE
ORION Local Sales Only
Starlight Xpress Ltd.
- Telescopes, Binoculars, Eyepieces & Accessories.
- Astronomy Books & Supplies.
- Amateur & Shortwave Radio

Radio City Inc.
2663 County Road I
Mounds View, MN, 55112
763-786-4475
radiocity@skypoint.com
BUY • SELL • TRADE
800-426-2891
www.radioinc.com

T&T BINOCULAR MOUNTS & BEYOND LLC

Cooler than an action figure. Better than a doll set. **The Kid's Mount!** Can carry 70mm. $60 (plus s+h)
18 Strong St. Extension
East Haven, CT 06512
(203) 469-2845 or (203) 272-1915
E-mail: TELloyd@aol.com
www.benjaminsweb.com/TandT

SURPLUS SHED℠
SURPLUS OPTICS AND ELECTRONICS
FREE CURRENT LIST
Phone/fax/faxback TOLL FREE:
1-877-7SURPLUS • 610-926-9226
E-Mail: SURPLUSHED@aol.com
WWW: http://www.SurplusShed.com
407 U.S. Route 222, Blandon, PA 19510

10 x 7 – $1795
10 x 8.5 – $1995

It will change the way you look at the stars

Sky Tent®
- Simple 1-person setup–25 min, no tools
- Highly UV resistant
- Dome rotates 360° on stationary base
- Stable in 60mph+ wind
- Weighs 100 lbs, packs easily in car
- Blocks local light pollution
- Eliminates wind vibration & chill
- Withstands heavy rain & snow
- Several sizes, from $1795
- Portable or permanent installation

www.skytent.com TOLL FREE 1-877-SkyTent

STARMASTER PORTABLE TELESCOPES
Hi Performance Dobs. Truss Mounted Scopes ranging in sizes from 12.5 " F-6 up to 22" F-4.5.
Route 1, Box 780 • Arcadia, KS 66711
or Call: (316) 638-4743
9:00 am - 9:00 pm C.S.T. 7 days a Week.
http://www.icstars.com/starmaster

CELESTRON®
MEADE

21072 - $299.99
31052 - $349.99
DS-70EC - $349.99
ETX-60AT - $299.99

AES®
1-800-558-0411
www.aesham.com
5710 W. Good Hope Rd • Milwaukee, WI 53223
Local line: (414)358-0333 • info@aesham.com
Call for other available models.

SPACE ART
satisfaction guaranteed

PAINTINGS
PRINTS
POSTERS
CARDS
BOOKS
SCREEN SAVERS

We are the world's only space art gallery, with the largest selection of dazzling visions by the world's finest space artists.
Prompt Friendly Knowledgeable

EXCLUSIVE gallery for paintings from astronaut-artist
ALAN BEAN
limited editions also

Moonwalker
autographed photos
authenticity guaranteed
Flags, patches and artifacts
FLOWN TO THE MOON
authenticated by the Apollo astronauts themselves

NOVASPACE galleries
Box 37197-H
Tucson, AZ
85740
catalog $3
($5 Int'l)
order online **www.novaspace.com**

ADORAMA INC.

42 WEST 18th STREET • NEW YORK, NY 10011

PHONE ORDERS ACCEPTED DAY OR NIGHT
- Mon–Thurs. 9 till 9:30 PM
- Fri. 9-1:45
- Sunday 9:30–6 EST

STORE HOURS:
- Mon.–Thurs. 9–6:30pm
- Fri to 1:30 • SUN 9:30–5:30

web: www.adorama.com

ORDER TOLL FREE • US & CANADA
800-7-ADORAMA
800-723-6726

ORDERS & INFO **212-647-9800** FAX **212-675-8715**

CUSTOMER RELATIONS • 800-815-0702 • Mon–Thur. 9–4:30, EST

E-mail: info@adoramacamera.com

USED TELESCOPES

READY TO UPGRADE YOUR TELESCOPE?
CALL US FOR AN EVALUATION
LOOKING TO BUY A USED TELESCOPE?
We Deal in Previously Owned Telescopes & Spotting Scopes

CELESTRON®
SCHMIDT CASSEGRAIN

ULTIMA 2000	**2699.95**
Celestar 8	**Call**
Celestar 8 computerized	**1699.**
Hand Control f/Celestar	**54.95**
Celestar 8 Deluxe	**1699.95**
8" S.C. Tube only	**649.95**
G-8 German Eq. 8"	**999.95**

New Celestron Nexstar

Nexstar 5	**1199.95**
Nexstar 8 W/Tripod	**1899.95**

Call About $100 Instant Cash Rebaate

Celestron Reducer/Correct or f/6.3

Works with all Current Celestron and Meade Schmidt Cassegrains. Now it is possible to have a dual focal ratio instrument without sacrificing image quality. The Reducer/Corrector is f/6.3 for C8 and C11, f/7 for C14. A four element, fully multi-coated accessory. Results are amazing BOTH visually and photographically.

104.95

ACCESSORIES for NEXSTAR 5"
JMI

Motofocus	**99.95**
Megapod Tripod w/Wedge	**214.95**
Carry Case	**134.95**
Celestron Tripod	**174.95**
Celestron Case	**149.95**

CELESTRON TELESCOPE ACCS.

AC Adpt. C5+, C8+ Ultima	**18.95**
Car Bat. Adpt. C5+,C8+ Ultima	**19.95**
2X Barlow 1.25" Short Tube	**39.95**
Counterweight Bar Assembly 8"	**84.95**
Case for C8/C5	**179.95**
Piggyback Mt 8"	**34.95**
Piggyback Bar Assembly 11"	**69.95**
Dewstar/Shade 8"	**24.95**
New Folding Lens Shades	**Call**
MOTORS	
DEC Motor C5	**64.95**
JMI DEC Motor C8+/Classic 8	**74.95**
Classic 8 Nekster 8	**89.95**
Celestron Focus Motor	**109.95**
Logic Drive f/CG3	**29.95**
S/A Drive w/Hand Cntrl f/CG-3	**79.95**
Single Axis Motor for CG-4	**64.95**
Single Axis Motor for CG-5	**114.95**
Dual Axis Drive for CG-4	**159.95**
Dual Axis Drive for CG-5	**169.95**
ADVANCED ASTRO MASTER	
Advanced Astro Master for C8 11, & G5 Mount	**474.95**
FILTERS	
LPR A	**59.95**
LPR B	**84.95**
Pol. Set 1¼"	**44.95**
Sky Filter #2	**44.95**
4 piece 1.25" FilterSet	**49.95**
DIAGONALS	
Diagonal Erect 1.25" 45°	**39.95**
Diagonal Erect 1.25" 90°	**49.95**
Star Diagonal 1.25" 90°	**34.95**
2" Mirror Star Diagonal	**124.95**
FINDERSCOPES	
9x50 Finderscope Kit	**79.95**
6x30 Finderscope Kit	**34.95**
7x50 Polaris Finder Scope with Illuminator & Bracket	**159.95**
Quick Release f/7x50 find	**42.95**
Star Pointer Finderscope	**24.95**
Polar Axis Finder f/CG-4/5	**44.95**
1.25" RACK & PINION FOCUSERS	
1.25" Focuser	**29.95**
GUIDING SYSTEM	
Radial Guider	**84.95**
Micro Guide Eyepiece	**139.95**
10mm Plossl Reticle	**84.95**
20mm Cross Hair Eyepce.	**34.95**
Standard Illuminator	**39.95**
TRIPODS & MOUNTS	
Adj. Tripod Heavy Duty	**264.95**
CG-3 Equatorial Mnt.	**149.95**
CG-4 Equatorial Mnt.	**299.95**
CG-5 Equatorial Mnt.	**399.95**
CZ-700 Mount	**1850.00**
Photo Tripod	**99.95**
Vibration Suppression Pads	**39.95**
NIGHT VISION ASTROLIGHTS	
Night Vision LED Light	**14.95**
T-ADAPTER/TELE EXTENDERS	
Tele Extender Deluxe	**48.95**
T-Adapt. f/Schmidt Cassegrains	**24.95**
T-Adapter/Barlow Lens 1.25"	**39.95**
T-C 16mm Adapter	**29.95**

ULTIMA EYEPIECES

5mm, 1¼"	**67.95**
18mm 1¼"	**67.95**
35m 1¼"	**96.95**
7.5, 1¼"	**67.95**
30mm, 1¼"	**84.95**
2X Ultima Barlow Lens	**62.95**
12.5mm, 1¼"	**67.95**
42m, 1¼"	**89.95**

PLOSSL EYEPIECES

7.5, 17mm, 1¼"	**31.95**

NEW NEXSTAR PLOSSL EYEPIECES 1.25"

3.6,6,8,10,13,17,25mm	**39.95**
32, 40mm,	**49.95**

NEW AXIOM EYEPIECES

15mm 1¼"	**129.95**
19mm 2"	**169.95**
50mm 2"	**274.95**
19mm 1¼"	**139.95**
34mm 2"	**209.95**
23mm, 1¼"	**149.95**
40mm, 2"	**249.95**

Vixen Lanthanum Eyepieces LV Series

2.5mm,	**99.95**
4mm	**94.95**
6mm	**94.95**
12mm	**109.95**
5mm	**94.95**
9mm	**94.95**
15mm	**94.95**
10mm	**94.95**
8-24mm Zoom	**159.95**

Pentax XL SMC Eyepieces

5.2, 7, 10.5, 14, 21, 28mm, 1.25"	**219.95**
40mm, 2"	**239.95**

Write or Call for a **FREE Binocular, Spotting Scope, Telescope Catalog**
Call **800-815-1259**
Ask for the Astro Catalog

CELESTRON

REFLECTORS

C-114 HD 4.5" Heavy Duty Premium Reflector

8" Reflector	699.95
C-150 Heavy Duty 6" Reflector	499.95
C-114 HD *Premium Optics, CG-4 Heavy German Equatorial Mount with Adj. Aluminum Tripod, 6x30 Finderscope, 20mm Plössl Eyepiece*	**Call**
Firstscope 114 Deluxe	**Call**
Firstscope 114 Premium	**Call**

New C-102 HD 4" Fully Multi Coated Heavy Duty Refractor

STAR HOPPER Dobsonian

4.5"	**239.95**
6"	**339.95**
8"	**429.95**
6x30 LER Finderscope	**39.95**

REFRACTORS

New C-150 6" *Equatorial Reflector,*	**Call**
C-102 HD 4" *Fully Multi-Coated Reflector, CG-4 Heavy German Equatorial Mount with Adj. Aluminum Tripod, 6x30 Finderscope, 20mm Plössl Eyepiece*	**499.95**
New C102 HD Altazimuth	**399.95**
New C80 Heavy Duty	**Call**
Firstscope 80 Equatorial	**Call**
Firstscope 80 W.A. Equat.	**299.**
Firstscope 70	**Call**
Firstscope 60 Alt. Deluxe	**139.95**
Firstscope 60 Equatorial with Aluminum Tripod	**124.95**

SPOTTING SCOPES

C90 MC w/1.25" Eyepiece	**Call**
Ultima 65	**129.95**
Ultima 80	**209.95**
15-60X Zoom	**Call**
80mm Wide Field with 2 Plossl Eyepieces	**Call**
New 102mm Wide	**Call**
500 f/5.6 Spotting Scope	**249.95**
f/4 Adapter for 500/5.6	**74.95**

COMPACT G3 3.5" & G5 5" SCHMIDT CASSEGRAINS

with Equatorial Mounts

G-3 3.5" w/Motor Drive $399.95

G-5 5" $699.95

Free 10mm Eyepicec w/ purchase of G3/G5 Telescopes

Tele Vue®

WE STOCK THE COMPLETE LINE
of Tele Vue Plossls, panoptics, Naglers, Radians, Barlows & Powermates

TELE VUE REFRACTORS

PRONTO
70mm Aperture f/6.4 with ED Glass
925.00

101mm and 85mm REFRACTORS

101mm	**2760.00**
85mm	**1995.00**

BUSHNELL

60mm Zoom Voyager Refractor	**79.95**
60mm Zoom Voyager Refractor with Rotary Eyepiece	**89.95**

Bushnell Compact 4.5" Reflector *$154.95*

Features a unique cradle mount which is convenient to use and transport. A wide field of view makes it easy to locate objects and keep them in view
- Aperture: 4.5" • Focal Length: 400mm
- Eyepieces: 1.25" 4mm (100X), and 25mm (16x)
- Focuser: Precision Rack & Pinion,

Tripod adaptable, includes convenient shoulder strap

SKYGAZER SERIES TELESCOPES

LIMITED TIME OFFER
80mm Refractor includes a FREE Single Axis Drive

90mm SKYGAZER EQUATORIAL

Refractor Includes 3 high quaility 1.25" eyepieces (6.5, 10 and 25mm) Short tube Barlow, T-adapter, Adjustable tripod with tray, slow motion controls, 6x30 finder **279.95**

80mm Equatorial

910mm focal length (f/11.4) German Equatorial Mount, slow motion controls, setting circles, 25mm 1.25" eyepiece (36X), 1.25" diagonal, 6x30 finderscope, adjustable wood tripod .... only **249.95**

SKYGAZER 60 EQUATORIAL

900mm f/15 Refractor, **Two 1.25" Eyepieces,** German Equatorial Mount, Slow Motion Cables, Setting Circles in both axes, 6x24, Finderscope, Hybrid 1.25" Diagonal, Adjustable Hardwood Tripod ....only **139.95**

SKYGAZER 114
(4.5)

LIMITED TIME OFFER
includes a FREE Single Axis Drive

Equatorial Deluxe Reflector Telescope
$199.95

114mm diameter Reflector with German Equatorial Mount, Slow Motion Controls in R.A. and DEC., 5x24 Viewfinder, Two 1.25" 25mm (36X) & 10mm (91X) Eyepieces, Adjustable Wood Tripod with Accessory Tray

STEREO BINOCULAR VIEWER $469.95

TELESCOPE ACCESSORIES

DEW SHIELD

Collapsible, fold down, easy to store and transport

for Celestron C90	**18.95**
f/8" Schmidt Cassegrains	**28.95**
f/5" Scopes	**24.95**
f/10" Schmidt Cassegrains	**38.95**
f/11" Scopes	**49.95**

LUMICON FILTERS

BUY ANY 2 FILTERS AND TAKE 7% OFF THESE PRICES

UHC Premium, Deep Sky Premium, H-Beta or Oxygen III

1¼"	**99.50**
48mm	**199.95**
2" T Mount	**199.95**

TELRAD FINDER

TELRAD with Base	**36.95**
Spare Mounting Base	**7.95**
Dew Shield for Telrad	**11.95**

EASY TESTER

Optical Evaluation Eyepiece	**29.95**

JMI FOCUSERS

NGF-DX1	**249.00**
NGF-DX2	**185.00**
NGF-S w/Motofocus	**249.00**
NGF-DX3	**149.00**

SOLAR FILTERS GLASS

for Celestron C90/G3 & Meade ETX	**59.95**
for Televue Genesis/101	**59.95**
for Pronto/Ranger Televue	**49.95**
for Celestron 5"	**69.95**
for Schmidt Cassegrains 8"	**89.95**
for Meade 10"	**109.95**

WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY

No Surcharge for MasterCharge or Visa Purchases. Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. Wa are not authorized Meade dealers.

Prices effective till Oct. 10, 00 **Please address all inquiries and orders to ASTRO. DEPT. #55**

FOR MORE ITEMS SEE OUR AD ON THE NEXT PAGE

BBB MEMBER METROPOLITAN NEW YORK

ADORAMA INC.

42 WEST 18th STREET • NEW YORK, NY 10011

PHONE ORDERS ACCEPTED DAY OR NIGHT
- Mon–Thurs. 9 till 9:30 PM
- Fri. 9-1:45
- Sunday 9:30–6 EST

STORE HOURS:
- Mon.–Thurs. 9–6:30pm
- Fri to 1:30 • SUN 9:30–5:30

web: www.adorama.com

ORDER TOLL FREE • US & CANADA
800-7-ADORAMA
8 0 0 - 7 2 3 - 6 7 2 6

ORDERS & INFO **212-647-9800** | FAX **212-675-8715**

CUSTOMER RELATIONS • 800-815-0702
• Mon–Thur. 9-4:30, EST
E-mail: info@adoramacamera.com

BINOCULARS

Adorama Provis Series Binoculars

Deluxe, Lightweight with enhanced Multi-Coating. Full-sized binoculars in a compact and lightweight high-quality cast-aluminum alloy housing with a soft leatherette covering.
- BAK-4 glass porro prisms.
- Full Multi-Coating. Every air-to-glass surface is multi-coated to increase light transmission, better image contrast and color balance
- Soft grey leatherette covering
- Threaded to accept tripod adapter
- Long Eye Relief. ideal for eyeglass wearers
- Roll down rubber eyecups
- Supplied with Deluxe Hard Carrying Case
- Rated "Exceptional Inspection Standard" by the Japanese J.T.I.I.

PROVIS Binocular	Eye Relief	Field of View	Near Focus	Size HxW	Weight oz.	Price
8x42	16mm	6.5°	16'	4.92" x 6.85"	22.2	**139.95**
7x50	23mm	6°	26'	6.42" x 7.24"	27.8	**124.95**
10x50	16mm	5.3°	26'	6.22" x 7.24"	27.8	**139.95**

NIGHT VISION

BINOCULARS
Compact Binocular 30,000X 4X Mag. 399.95
30,000X Goggles 1X Mag. Focuses as close as 9" ..574.95

MONOCULARS

Compact 5X Magnification 10,000X Light Mag. . .239.95
NOCX3 Explorer water Resistant 3.1X Mag. 15,000X . .199.95
NOCX5 Explorer water Resistant 5X Mag. 15,000X . . .274.95
NONO3 Odyssey water Proof 3.1X Mag. 15,000X249.95
Lens Doubler . .34.95 Camera Adapter .34.95

TASCO
NV-360 **Monocular** 279.95
Camera Adapter for 360 . . . . .49.95

Night Owl Cyclops Emerald™ With Camera Adapter

- 15,000 Light Magnification
- 3.1x Image Magnification
- Premium performance and styling
- The highest quality optics designed and coated specifically for night time use
- Powerful integrated infrared illuminator ***164.95***

ASTRONOMY BOOKS

Books for Beginners
Nightwatch: Equinox Guide ...**24.95**
Astronomy: Self-Teach Guide **18.95**

Astrophotography & Imaging
CCD Camera Cook Book..........**29.95**

Observers' Handbooks
The Backyard Astronomer's Guide **29.95**
Burnham's Celestial Handbook 3 Volume Set **39.95**

Binocular Observing
Touring the Universe Through Binoculars **32.95**

Building Telescopes
Telescope Building w/Dobson Video Tape........**39.95**

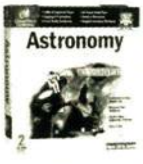
Star Atlases
Sky Atlas 2000 Field Ed. **29.95**
Sky Atlas 2000 Deluxe New Ed. **44.95**
Laminated Sky Atlas 2000 Field Edition **64.95**
Bright Star Atlas 2000 ....**10.95**
Celestron Sky Map.................**16.95**
Atlas of Deep Sky Splendors 4th Edition **24.95**
Deep-Sky Field Guide to Uranometria 2000 ....**49.95**

Night Navigator $79.95
The Electronic Star Locator

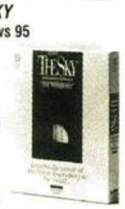
Locates and Identifies Constellations Quickly.
- Scientific patented computer tracking system to accurately locate and identify constellations, planets, and stars quickly and effortlessly.
- Innovative built-in digital electronic compass automatically plots your location.
- Motorized map delivery system for easy sky navigation.

ASTRONOMY SOFTWARE

NEW RED SHIFT
(Astronomy)
29.95



THE SKY
for Windows 95
Version 5.0
Sky Level 2 or 3 ....**Call**
Sky GSC (CD ROM) Level 4 ..**Call**



PRO OPTIC BINOCULARS

These binoculars with their large objectives high quality BAK-4 prisms will provide you with breath-taking wide-field observation of astronomical objects as well as terrestrial viewing under low light conditions.

Now includes 25 YEAR WARRANTY

Each binocular is provided with a high quality Hard Case, Neck Straps and Rubber Eye-Cups.

70mm Jumbo Fully Multi-Coated Series

11x70 Jumbo – 4º field of view, 21mm eye relief, weighs 2.8 lbs. **159.95**
16x70 Jumbo– 3.6º field of view, weighs 2.8 lbs. **169.95**

80mm Giant Fully Multi-Coated Series

11x80 Giant – 4.2º field of view, 14mm eye relief, weighs 5.25 lbs. **249.95**
20x80 Giant – 3.3º field of view, 14mm eye relief, weighs 5.25 lbs. **259.95**

100mm Ultra Giant Series

The ultra large aperture of 100mm provides more than 50% more light gathering power than the standard 80mm Giant Binoculars.
For a delightful experience in astronomical viewing.
Both feature multi-coated optics, BAK-4 prism, built-in platform which mounts on a tripod.

14x100 Ultra Giant ...**849.95** **25x100** Ultra Giant .**899.95**

Provides Stunning Views of The Night Sky
At A Price Far Below What Giant Binoculars Typically Cost
...BUDGET - PRICED...
As Written Up In Sky & Telescope June 2000

FUJINON FMT-SX Binoculars

14x40 Techno Stabi...............**Call**
7x50 FMT-SX........................**Call**
7x50 FMTR-SX ....**Call**
7x50 FMTR-CSX R.C.with Compass ....**Call**
8x30 FMTR-SX R.C. ....**Call**
10x70 FMT-SX w/Case ....**Call**
16x70 FMT-SX w/Case ....**Call**
Tripod Adapter – Large **19.95**
8x42 BFL............................**229.95**
10x42 BFL **234.95**

CD Waterproof
7x42 ....**Call** 8x42............**Call**
10x42 ....**Call**

CANON
$50 Rebate Call f/Exp.
Image Stabilized
10x30 ....**Call** 12x36 ....**Call**
15x45.....................................**Call**
New 15x50 ....**Call**
New 18x50 ....**Call**

PENTAX PCF
7x50............**Call** 8x40. ....**Call**
10x50..........**Call** 12x50. ......**Call**
16x50..........**Call** 20x50. ......**Call**
New 20x60 ....**Call**

LEICA
w/USA Passport Warranty
10x50 BA ....**Call** 8x50 BA.....**Call**
12x50 BA...............................**Call**
7x42 GEOVID BDA ....**Call**
7x42 GEOVID BD ....**Call**

KOWA
82mm Spotting Scopes (Body only)
TSN-821.**399.95** TSN-822 **364.95**
TSN-823.**814.95** TSN-824 **769.95**
82mm Scopes with 20-60X Zoom
TSN-821 with 20-60X Zoom..**639.95**
TSN-822 with 20-60X Zoom .**609.95**
TSN-823 with 20-60X Zoom**1039.95**
TSN-824 with 20-60X Zoom **999.95**

GIANT BINOCULARS
25x150 ED EM........................**Call**
25x150 EM.............................**Call**
40x150 ED MT.........................**Call**

Fieldscope Super 80
Super 80 with 20X-60X...........**Call**
Super 80 ED with 20X-60X ....**Call**

CELESTRON
GIANT MULTI-COATED
20x80 B...**269.95** 20x80 Dlx ...**Call**
REGAL
8x42...........**Call** 10x50 ....**Call**
ULTIMA SERIES
7x50............**Call** 8x40. ....**Call**
10x50..........**Call** 8x56 ....**Call**
9x63............**Call**
MINI M/C with Case
8x21.......................................**39.95**
10x25 ......**46.95** 7-16x25 .**64.95**
MONOCULAR– 8x25..............**34.95**

BUSHNELL
Discoverer 15-60 X60........**179.95**
Camera Mount f/Discoverer ...**14.95**
Spacemaster **149.95**
Spacemaster Rubberized ...**163.95**
Spacemaster Kit w/15-45X, Tripod and Case..............**247.95**
Elite 60mmw/15-45X Zoom ....**Call**
Elite 70mm w/20-60X............**Call**
Elite 80mm w/20-60X............**Call**
Elite 77mm ....**Call**
Eyepieces & Accessories ....**Call**

PRO OPTIC Astronomical Accessories

A unique combination of high quality and economical prices

Pro-Optic Plössl 1.25" Eyepieces

NEW Reduced Prices!
PRO-OPTIC

- Sharp detail • High contrast ghost-free images • Wide 50º apparent field of view (43º on the 40mm Plössl)
- 4 element optics
- Lens edges are blackened to keep out reflected light
- Accepts 1.25" filters.

MULTI-COATED PLÖSSL EYEPIECES
40mm......**39.95** 32mm.......**39.95**
25mm.......**29.95** 20mm.......**29.95**
17mm.......**29.95** 12.5mm....**29.95**
10mm.......**29.95** 7.5mm......**29.95**
6.3mm.......**29.95**

Short Tube Barlow

Double the power of any eyepiece with this Barlow. Only 2¼" long. Works with all type of telescopes, including Refractors and Reflectors

only **$31.95**

Pro Optic 500mm f/5.6 Maksutov Telephoto/Spotting Scope

with High-Tech White Finish

Carry Case

Multi-coated to maximize contrast and sharpness and a built-in field flattener to reduce field curvature.
With its 500mm focal length, it is long enough for close-ups of far away objects but with the f/5.6 optics it is fast enough to be hand held, focuses as close as 5 feet.
With the addition of the SS500 Kit you can convert it to a 20X 90mm spotting scope. The SS500 kit includes a 45º 1.25" Erect Image Diagonal and a 25mm 1.25" Plossl

Pro-Optic 500mm f/5.6 lens **209.95**
Pro-Optic SS500 Kit (when purchased w/500/5.6)................**49.95**
350mm f/4 Converter for 500/5.6.......................................**74.95**

15-45x Fieldstar Spotting Scope Outfit Fully Coated, 2.25° f.o.v. at 15x, Long Eye Relief (33mm @ 15x) weighs only 25 oz,
• Rubber Coated
includes Case & Table Top Tripod

109.95

New 15-45x Angle Spotting Scope Kit w/Case & Table Top Tripod **119.95**

Pro-Optic Slow Motion Control ***29.95***

Make accurate slow motion adjustments in altitude and Azimuth. In addition the Pro-Optic SMC allows you to make major adjustments in elevation with a separate control knob.The Slow Motion Control fits any tripod with 1/4-20 thread.

Pro-Optic 45º Erect Image Diagonal

Provides an ideal 45º angle for erect image terrestrial viewing
45º Erect 1.25"...**34.95**
45º Erect Hybrid (1.25" to .96")....................................**34.95**
90º Star Diagonal 1.25"..**34.95**
New Straight Through Erector (Porro Prism) **64.95**

EYEPIECE FILTERS 1.25"

Available in the following colors: 1A Skylight; 8 Yellow; 11 Yellow Green; 12 Deep Yellow; 15 Deep Yellow; 21 Orange; 23A Red; 25 Red; 47 Violet; 56 Light Green; 58 Green; 80A Lt. Blue; 82A Pale Blue; ND 0.3; ND 0.6

1.25" ....@. **9.95** Moon Filter 1.25" (ND 9X).........**11.95**
Buy any 4 filters (1.25")...for only **34.95**
Buy any 12 filters.............for only **99.95**
4 Piece Filter Set with Pouch
Set #1 includes: #12, 23A, 58 & 80A Packaged in a Pouch **34.95**
Set #2 includes: #11, 25A, 47 & 82A **34.95**

WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY
No Surcharge for MasterCharge or Visa Purchases. Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. Wa are not authorized Meade dealers.
Prices effective till Oct. 10, 00 **Please address all inquiries and orders to ASTRO. DEPT. #55**

FOR MORE ITEMS SEE OUR AD ON THE PREVIOUS PAGE

Astronomy's

Retail & Travel Directory

The Directory is designed to be a quick and easy way to locate astronomy-related retail stores, activities, planetariums and observatories. To advertise call toll free 1-888-558-1544 ext. 815

RESORTS

TEXAS - Alpine 79830

TERLINGUA RANCH RESORT

Some of the darkest skies in the United States!
Remote, Quiet & Beautiful!
Adjoins Big Bend National Park.
Two hours from McDonald Observatory.
Cabins, RV Sites & Camping. For information:
www.terlinguaranch.com

HC 65 Box 220 (915) 371-2416

RETAIL SHOPS

ARIZONA - Phoenix 85032

THE ASTRONOMY SHOPPE

Telescopes (Meade, Celestron, Tele Vue®, Orion, Takahashi) • Spotting Scopes • Binoculars
Eyepieces & Accessories • Maps • Books • Sky Tours
We welcome mail orders. Visa/MasterCard accepted.
astroshop@earthlink.net www.darkskyinc.com

3202 E. Greenway Rd. Suite 1615 (888) 999-6396

When traveling, use the Retail & Travel Directory as your guide.

CALIFORNIA - Oceanside 92054

OCEANSIDE PHOTO & TELESCOPE

OPT

19th Annual Winter Telescope
Demonstration, Star Party
& Sale
Saturday, November 11th
CELESTRON DAY
Celestron reps will be there
Saturday, November 18th
MEADE DAY
Meet the Reps
opt@optcorp.com

1024 Mission Ave. (800) 483–6287

FLORIDA - Sarasota 34236

WOLF CAMERA

Telescopes
Meade
Celestron
Tele Vue®

CCD Equipment
Meade Pictor
Optec Max.
Accessories

WOLF CAMERA

The Largest Telescope Dealer in the Southeast!
New & used telescopes, CCD equipment & accessories, plus a huge selection of eyepieces and binoculars! Call Chuck Pisa our staff Astronomer with 20 years experience today!
www.wolfcamera.com Fax: (941) 952-0278

1055 S. Tamiami Trail (941) 957-4686

RETAIL SHOPS

FLORIDA - Tampa 33612

THE FAMILY ASTRONOMER

Telescopes • Binoculars • Eyepieces • Accessories
Specializing in "Family" Astronomy! Celestron • Meade
CCD • Software Expert help in choosing the right telescope. www.thefamilyastronomer.com
hjastro@gte.net Fax:813-936-1734 Info:813-909-7689

1206 East Busch Blvd. (Orders Only): 800-537-2866

GEORGIA - Atlanta 30306

CAMERA BUG

TELESCOPES • BINOCULARS • ACCESSORIES
EYEPIECES • SPOTTING SCOPES • MAPS • BOOKS

Canon • Celestron • Meade • Minolta • Olympus
Orion • Pentax • TeleVue®

WE SHIP ALMOST ANYWHERE!
www.camerabug.com
Fax: (404) 873-3925
Orders Only: (800) 545-8509

1799 Briarcliff Rd. (404) 873-4513

NEW MEXICO - Belen 87002

NMA NEW MEXICO ASTRONOMICAL

BEFORE YOU BUY... COME TO THE COUNTRY AND TEST EQUIPMENT UNDER DARK SKIES!
Full range of sizes on display!
Telescopes • Eyepieces • Mounts • Accessories
All major brands. www.nmastronomical.com

834 N. Gabaldon Rd. (505) 864-2953

NEW YORK - Amityville 11701

BERGER BROS.

CAMERA•VIDEO•DIGITAL

In Business Over 50 Years.
"We Don't Just Sell It... We Use It!"

TELESCOPES•BINOCULARS•CAMERAS
We Carry: Meade • Celestron • Swarovski
Leica • Zeiss • Steiner • Fujinon • Pentax
Bausch & Lomb • Bushnell • Nikon • Canon
Catalog Available • We Ship Nationwide
http://www.berger-bros.com

Phone: (516) 264-4160 Fax: (516) 264-1007

209 Broadway (Route 110) (800) 262-4160

TEXAS - Dallas 75252

THE OBSERVATORY, INC.

The Most Complete Telescope Store in Texas

TELESCOPES * MICROSCOPES * BINOCULARS

In the field set-up & instruction with every Astronomical Telescope purchase
Astronomical Telescopes * Spotting Scopes
Binoculars & Giant Binoculars * Sky Charts
Atlases, Books * Computer Controlled Telescopes
Astronomy Software

Celestron, Meade, Orion, Tele Vue®, Geochron, Canon, Swift, Sperical Concepts, Fujinon
Home-Dome by Technical Innovations

www.TheObservatoryInc.com

19009 Preston Rd., Suite 114 (972) 248–1450

RETAIL SHOPS

TEXAS - Fort Worth 72126

SKYWATCH PRODUCTS

North Texas' Most Affordable
Telescope and Accessories Source
Look Through (day or night) before buying.
Knowledgeable and friendly staff. Extensive showroom inventory. Astronomy classes available.
Shipping available. Fax (817) 249-5762.
http://members.aol.com/skywatchpr/home.html

7600 Benbrook Pkwy. #5 (817) 249-3767

TEXAS - San Antonio 78250

Analytical Scientific™

"The Source For All Your Astronomy Needs"

Visit our showroom and see the largest selection of telescopes in Texas. Meade, Celestron, Tele Vue®.
Telescopes, binoculars, microscopes, spotting scopes, accessories, books, charts, posters.
Science, nature and educational items.
E-Mail: asltd@analyticalsci.com
http://www.analyticalsci.com Fax: (210) 520-3344

11049 Bandera Rd. (800) 701–STAR (7827)

CANADA- Ontario - Burlington L7L 2A4

SKY OPTICS

Telescopes, binoculars, eyepieces, CCD's, & accessories.
Lowest prices, expert advice, Canada delivery.
Meade, Tele Vue®, Celestron, SBIG, Lumicon, Kendrick, Software Bique, & more!
www.skyoptics.net

4031 Fairview St. Unit 216B (905) 631-9944

CANADA - Ontario - Toronto M6A 2T2

Shop on-line at www.khanscope.com

MEADE APD PRODUCTS

Our 14th Year!

RETAIL & MAIL ORDER
NEW & USED TRADE-INS!!

Celestron • Meade • Tele Vue® • Skywatcher
Binoculars • Spotting Scopes • Books,
Software • Low Prices
All Major Brands on Display
We Welcome trade-ins, Buy Used. Repairs & Service.
Toll Free (800) 580-7160

KHAN SCOPE CENTRE Ph. (416) 783-4140
3243 Dufferin St. Fax (416) 783-7697

CANADA - Ontario - Toronto M6A 3A4

EfstonScience

SERVING OBSERVING SINCE 1970!

Just look for the giant telescope on our roof!

MEADE APD CELESTRON

Science & Astronomy Superstore.
All major brands on display. Free Literature.
We welcome trade-ins, buy used, do service.
Dobsonians in stock: 6" - 17 1/2"
www.e-sci.com Fax: (416) 787-5140

3350 Dufferin St. (416) 787-4581

Call 1-888-558-1544, Ext. 396 to advertise in the Retail & Travel Directory.

RETAIL SHOPS

CANADA - Vancouver V6J 1M4

HARRISON

Telescopes, Binoculars, Microscopes, Magnifiers,
Accessories, Books, Meteorological Instruments,
Dry Eye Dew Control Systems
Celestron • Meade • Bushnell• Bausch & Lomb
Pentax • Zeiss • Steiner • Olympus
email: harscope@direct.ca Fax: 604-737-4390
1859 West 4th Ave. (604) 737-4303

Astronomy's Classifieds

This section is open to anyone who wants to buy astronomy-related merchandise. *RATES:* $1.56 per word. Minimum charge is $14.00 per issue. Prepayment required. Frequency discounts available. All copy is set in standard typography. *CLOSING DATE:* 1st of the month, three months before the cover date (i.e., March 1st for the June issue). Send your ads to *Astronomy*, Classifieds, PO Box 1612, Waukesha, WI 53187-1612. 1-800-558-1544 ext. 815. Major credit cards accepted.

ACCESSORIES FOR SALE

Altazimuth platform kits for large dobsonians up to 250 lbs. Digital setting circle kit. Serial EZtracker finds faint objects. Equatorial platform kits. TL Systems, 2184 Primrose Avenue, Vista, CA 92083. (760) 599–4219. tlsystem@ix.netcom.com or http://www.netcom.com/~tlsystem/

Visiting Hawaii? Maui Skies offers star charts, planispheres and other products to enhance star-gazing in Hawaii, plus lots of information. Visit http://www.mauiskies.com or call toll-free 877-211-8669.

BINOCULARS FOR SALE

Do you have BIG EYES®? We have real BIG EYES® and more! www.tquestoptical.com (914) 944-3391

PUBLICATIONS AND WEB SITES

Astrosights. The amateur astronomy web directory and product listings. http://www.astrosights.com

COSMIC PERSPECTIVE, Revolutionary cosmology treatise, reveals big bang fallacy: www.webservr.com/science

NEW BOOK on STAR OF BETHLEHEM, a supernova in Aquila. $10.00 postpaid. www.starofmagi.com

DOMES & PORTABLE STRUCTURES

Telescope Enclosures - 6'dia., 7' tall, rotates 360°, portable or permanent--no zoning problems. Quality construction. $2K +. www.darksitedomes.com or 800-526-3887 for brochure.

LODGING/TOURS/TRIPS

Ecuador February 2001 with Greg Butcher and Paul Greenfield. BIRDER'S WORLD Magazine is sponsoring a special trip. Join us for one, two or all three segments: Amazon at Sacha Lodge, February 8-12; Andes, San Isidro Lodge and Hotel Tinalandia, February 12-17; Galapagos, February 17-27. For more details, contact Voyagers International (800) 633-0299 e-mail: explore@voyagers.com

Join ASTRONOMY Magazine on an African Eclipse Safari. Zimbabwe - June 10 - July 1, 2001. See the splendors of the sky while on a safari! Enjoy every second of the three-minute eclipse in a cloudless African sky. You'll share the experience with lions, elephants, buffaloes, hippopotamuses, impalas, and crocodiles, and witness the fascinating effect the eclipse has on these creatures. Choose the tour that best fits your personal schedule: June 10 - June 23, 2001 or June 19 - July 1, 2001. Both magnificent excursions include a fantastic view of the eclipse in a massive sky; first rate accommodations- both in the city and on the safari; a trip to the breathtaking Victoria Falls; and so much more. Join ASTRONOMY editors for an amazing adventure of a lifetime! Space is limited–don't delay! For more information, call Specialty Tours toll free (800) 677-9412, (727) 796-7555 or e-mail gs@alspecialtytours.com

Mountaintop Cabins for Rent. Located in the heart of the Davis Mountains of Texas. Hiking, birdwatching, stargazing. Phone (915) 426-2538; Fax (915) 426-2655; E-mail LLL@overland.net; mobile (915) 425-0542.

ANNOUNCEMENTS/OPPORTUNITIES

Free Information Package. International Marketing Firm is looking for New Products/Ideas. Patenting, Marketing & Design Services available. Call Concept Network 1-800-846-8368 ext. 202, 24 hours.

Midwest Birding Symposium 2001 is winging its way to Wisconsin! Mark your calendars now for the 2001 Midwest Birding Symposium (MBS). Thursday, August 30 through Sunday, September 2, 2001. Hosted by BIRDER'S WORLD Magazine, EAGLE OPTICS, & the WISCONSIN SOCIETY FOR ORNITHOLOGY. The symposium will offer a varied menu of speakers and field trips of the state, Green Bay is surrounded by wetlands that vary from Lake Michigan shoreline to cattail marsh and sedge meadow. The area lies along major pathways for fall migrants. The theme of Wetlands and Wetland Species will ring through the weekend of activities that will include birding field trips, visits to nature centers , museums and bay cruises. The roster of renowned keynote speakers continues to expand. The symposium will be held at the Regency Suites Conference Center in downtown Green Bay. For accommodations, call (800) 236-3330 and request the special MBS room rate. The Green Bay Area Visitors and Convention Bureau can be reached at (920) 494-9507 for lists of alternative lodging. Sponsors to date include Swift Instruments, Leica Sports Optics, Swarovski Optics, the Green Bay Area Visitor and Convention Bureau, and the Mosquito Hill Nature Center. Additional information can be found on the BIRDER'S WORLD Web site: www.birdersworld.com. For questions or registration, please contact Bill Hubert at (800) 558-1544 ext. 236; by fax at (262) 798-6592 or by e-mail at bhubert@kalmbach.com.

TELESCOPES FOR SALE

Brand new LX50 10 inch, receipts, includes tripod. $1,695.00 Meade 10 inch star finder, customized, many accessories included. $1,200.00. Call Roger (248) 673-6437

Close Encounters Telescopes: Check out our new website www.canadatelescope.com or Email: telescope@3web.net. (403) 818–4424, 5005 Macleod Trail South, Calgary, Alberta T2G 0A9.

Used Telescopes: Takahashi, Pentax, Vixen. Flutes, Ukiyoe Prints. http://www.net0726.ne.jp/~jhniemi

TELESCOPES WANTED

Wanted: used telescopes and accessories. Contact Gary Hand, 24045 Sugarcane Ln., Gaithersburg, MD 20882. (301) 253–5046.

NEXT month in Astronomy

Jay Ouellet

WOMEN IN ASTRONOMY

Fifteen women speak up about the good, the bad and the ugly sides of professional astronomy.

SORTING THE STARS

The turn-of-the-century ingenuity of two independent astronomers led to a novel understanding of the life cycles of stars.

FREEZE FRAME

Cold weather doesn't stop Canadian Jay Ouellet from his passion for astrophotography.

BECOMING AN ASTRONOMER

Future astronomers must temper their stargazing with advanced studies in math, physics, and computer skills.

To get your copy of the November issue, visit your local hobby shop or newsstand, or call

1-800-533-6644

Kalmbach Publishing Co., P.O. Box 1612,
Waukesha, WI 53187-1612

Visit our web site at

www.astronomy.com

Once thought to be the domain of scientists and the scholarly, astronomy is beginning to permeate our culture. During his July concert at Milwaukee, Wisconsin's Summerfest, singer/songwriter Don Henley mentioned Carl Sagan and the vast expanse of the universe while introducing a song about the unlikelihood of ETs visiting earth. A top-selling CD by Pearl Jam features a Hubble photo of the Hourglass Nebula. Movies, TV, books, advertisements, even greeting cards often make reference to astronomical subjects.

Star parties are reflecting this surge of interest with reported growths in attendance. What better way to capture the heart and imagination of a budding astronomer than to offer a glimpse of the true universe through the eyepiece of a telescope?

SEPTEMBER 28–OCTOBER 1

Enchanted Skies Star Party

Socorro, New Mexico. Contact The Enchanted Skies Star Party, P.O. Box 743-I, Socorro, NM 87801; (505) 835-0424; e-mail, chamber@socorro-nm.com; website, http://www. socorro-nm.com/starparty.html.

SEPTEMBER 28–OCTOBER 1

Great Plains Star Party

Scopeville, Kansas, 75 miles southwest of Kansas City. For information, contact Larry Madison, (816) 229–2394; e-mail, clearskysalways@hotmail.com; website, http://www.icstars.com/HTML/GreatPlains2000.

SEPTEMBER 28–OCTOBER 1

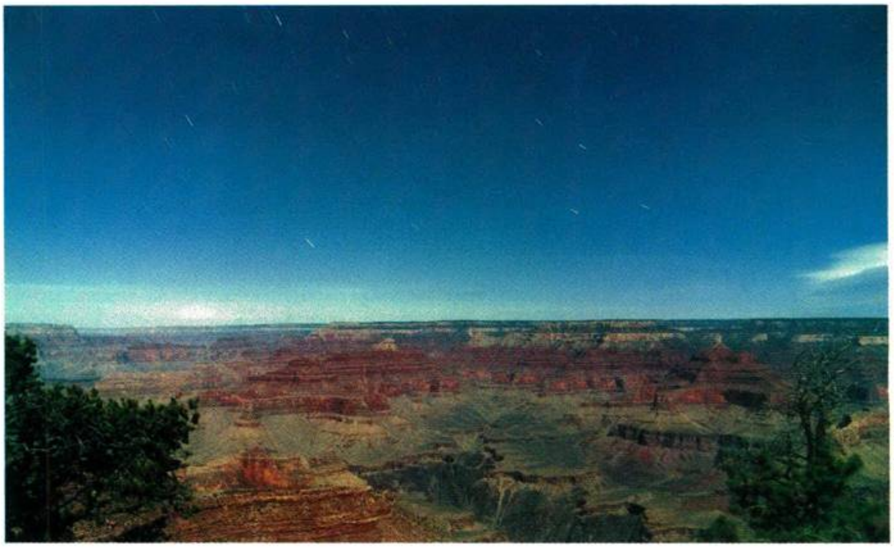
No-Frills Star Party

Tuckahoe State Park, Queen Anne, Maryland. For more information, contact Lyle Jones, (302) 736–9842; website, http://www.delmarvastargazers.org.

SEPTEMBER 29–30

Dark Sky Party

Cathedral Gorge Nevada State Park, Panaca, Nevada. Contact Jim Mellor, 2052 High Mesa Drive, Henderson, NV 89012, (702) 361–1356; e-mail, jbar2@vegas.infi.net.



Philip A. Dombrowski

The constellations Cassiopeia and Perseus extend as star trails over the south rim of the Grand Canyon.

SEPTEMBER 29–30

Hidden Hollow Convention and Star Party

Hidden Hollow Campgrounds, Mansfield, Ohio. Contact Hidden Hollow Conventions, P.O. Box 217, Ashland, OH 44805; Dave Hartsel, e-mail, dhartsel@earthlink.com.

SEPTEMBER 29–OCTOBER 1

South Jersey Star Party

South Jersey Astronomy Club, at Belleplain State Forest, Woodbine, New Jersey. Contact Paul Ostwald, 23 Isaacs Lane, Egg Harbor Township, NJ 08234; club phone, (856) 293–1584; e-mail, paostwald@aol.coml.

SEPTEMBER 29–OCTOBER 1

Whirlpool Star Party

County Arms, Birr, Co. Offaly, Ireland. Hosted by Shannonside Astronomy Club. *Astronomy*'s Managing Editor, David Eicher, will be speaking, among others. Contact David Bell, Bansha, Askeaton, County Limerick, Ireland, or e-mail, sdbell@gofree.indigo.ie.

SEPTEMBER 30

North Texas Skywatch Star Party

Lake Mineral Wells State Park, Mineral Wells, Texas. For reservations, call David Owens (940) 328–1171. For information, contact Michael Hibbs, (817) 249–3767; e-mail, Skywatchpr@aol.com.

SEPTEMBER 30

NOVA Star Party and Telescope Meet

Crockett Park, Midland, Virginia. Contact Jeff Cook, (703) 524–5333; e-mail, jeff@cookstudios.com.

OCTOBER 6–8

Autumn Astro-Tour

Ballreich Observatory, north of Tiffin, Ohio. Contact Tom Day, 4486 Peachton Drive, Port Clinton, OH 43452; e-mail, day@cros.net.

OCTOBER 7

Island Lake Star Party

Island Lake State Recreation Area, Brighton, Michigan. Contact FAAC, P.O. Box 7527, Dearborn, MI 48121-7527; hotline: (313) 390–5456; e-mail, faac1992@hotmail.com.

OCTOBER 13–14

Rhode Island Astroassembly

North Scituate, Rhode Island. Contact Steve Hubbard, 45 Church Street, Auburn, MA 01501; (508) 832–8746; e-mail, skyscrapers_ri@hotmail.com;

OCTOBER 23–27

Division for Planetary Sciences Annual Meeting

Pasadena Convention Center, Pasadena, California. Hosted by JPL. For information, telephone (818) 354–9056; website, http://www.aas.org/dps2000.

OCTOBER 24–29

Mid-Atlantic Star Party

Boy Scout Camp Reeves, South of Robbins, North Carolina. For more information, send a SASE to MASP, 244 Deerfield Road, Apex, NC 27502; (919) 362–5194; or e-mail John Dilday, john@masp.org; website, http://www.masp.org.

OCTOBER 25–29

Deep-South Regional Stargaze

Percy Quin State Park, near McComb, Mississippi. Contact Barry Simon, 842 Crystal Street, New Orleans, LA 70124; (504) 283–7592; e-mail, bsimon615@aol.com.

OCTOBER 27–29

Astronomy Camp for Beginning Adults

Mount Lemmon and Bigelow Observatories, University of Arizona, Tucson, Arizona. Contact Don McCarthy, 933 N. Cherry Ave., Tucson, AZ 85721; (520) 621–4079, e-mail, dmccarthy@as.arizona.edu; website, http://ethel.as.arizona.edu/astrocamp.

OCTOBER 27–29

Astronomy Workshop

Skeleton Lake Scout Camp, near Boyle, Alberta, Canada. Contact (780) 458–9345; e-mail, stansey@telusplanet.net; website, http://planet10.v-wave.com/rasc/mainrasc.html.

OCTOBER 27–29

Mount Magazine Star Party

Near Danville, Arkansas. Sponsored by River Valley Stargazers. Contact P.T. Barnum, 76 Observatory Lane, Dover, AR 72837; (501) 331–3620; e-mail, rvstargazer@yahoo.com; website, http://www.geocities.com/CapeCanaveral/Launchpad/2148/starparty.html.

OCTOBER 28, NOVEMBER 17

Shreveport Star Party

Ralph A. Worley Observatory, south of Shreveport, Louisiana. Contact Cran Lucas, (318) 797–1524; e-mail, clucas@softdisk.com.

CONTACT

Please submit club announcements four months in advance to Looking Ahead, *Astronomy*, P.O. Box 1612, Waukesha, WI 53187, or to tconley@astronomy.com. Look for additional events at http://www.astronomy.com.

AD INDEX

AES Amateur Electronic Supply	115
Adirondack Video Astronomy	113
Adorama	116, 117
Anacortes Telescope & Wild Bird	122
Andromeda Astronomy Mall	111
Astro Haven	114
Astro-Physics	114
Astronomical Adventures	114
Astronomical Society of the Pacific	112
Astronomics	62, 63, 122
Atomic Time	27
Beigle/Bryant Engineering	114
Bethany Sciences	113
CC Sales/Camera Corner, Inc.	122
C & J Photo, Inc.	122
Captain's Nautical Supplies	122
Casper, Michael I Meteorites	112
Cavendish Press	31
Celestron International	21, 33, 97
Clear Night Products	112
Coulter Optics	92
Discovery Telescopes, Inc	16
Eagle Optics	92, 122
Edmund Scientific Company	15
Edward R Hamilton Bookseller	113
eHobbies.com, Inc.	34, 35
Enchanted Skies Star Party	106
Equatorial Platforms	114
F. C. Meichsner Company	92, 122
Focus Camera	74, 75, 122
Fujinon	96
Howard Glatter	113
Gould Precision Optics	111
Hands On Optics	112
Hardin Optical Co.	99, 111, 114
Innovations in Travel	114
Internet Telescope Exchange	113
Into The Wind/The Kite Source	111
JMB, Inc	96
Jim's Mobile Industries	20
Kalmbach Publishing Co.	100, 105, 109, 119
Kendrick Astro Instruments	96
Learning Technologies, Inc.	114
Lumicon	60, 11, 122
Mag One Instruments	112
Marketplace Pages	111, 112, 113, 114, 115
Meade Instruments Corp	2, 3, 7, 8, 9, 10, 11, 12, 13, 130
Meta Research	31
Minerva Press	114
Mountain Skies Astronomical Society	113
MusicMaker.com	17
National Academy of Sciences	106
National Academy Press	27
New Mexico Skies	112
Newport Glass Works	115
Novaspace	115
Obsession Telescopes	112
Oceanside Photo & Telescope	99, 122
Optical Guidance Systems	113
Orion Telescopes & Binoculars	18, 19, 25, 107
Pegasus Optics	112
Pocono West Optics	93, 122
Radio City	115
Rainbow Symphony	113
Retail & Travel Directory	118, 119
Rivers Camera Shop	31, 122
Roger W. Tuthill, Inc.	108
SAC Imaging Systems	112
SCS Astro	113
Santa Barbara Instrument Group	91
Science Art Co.	113
Science Connection, Inc.	114
Scope City	104, 122
ScopeTronix	111
Shutan Camera & Video	101
Sky Watchers Inn	112
Skytent International	115
Software Bisque	29
Springer-Verlag New York, Inc.	103
Star Tek Industries	115
Starmaster Portable Telescope	115
Starsafaris.com	27
Starsplitter Telescopes	111
Surplus Shed	115
T &T Binocular Mounts & Beyond LLC	115
Technical Innovations	106
Telescope Engineering	111
Tele Vue Dealer Page	122
Tele Vue Optics, Inc	129
The Teaching Company	47
Travel Quest	115
Van Slyke Engineering	113
What In the World	114
Woodland Hills Photo Images	108, 122

Tele Vue® Dealers

CALIFORNIA

TeleVue® NAGLER™

4.8mm - 1 1/4" $175
7mm - 1 1/4" $220
9mm - 1 1/4"/2" $240
12mm - 1 1/4"/2" ..$340
17mm - 2" $370
22mm - 2" $445

82° Field Spoils You!

LUMICON
2111 Research Dr. #4-5
Livermore, CA 94550
1-800-767-9576

TeleVue®
Optics Specialists!
Eyepieces, Telescopes & Accessories

OPT Oceanside Photo & Telescope
1024 Mission Ave.,
Oceanside, CA 92054
800-483-6287
(760) 722-3348

email: opt@optcorp.com
http://www.optcorp.com

Complete Line of Quality Products

TeleVue®
Scope City
World's Largest Centers
EXPERT HELP!
MAIL ORDER: P.O. Box 440, Simi Valley, CA 93065
TEL: (805) 522-6670 • Fax: (805) 582-0292
www.scopecity.com

SIMI VALLEY, CA
730 Easy ST.
Simi Valley, CA 93065
TEL: (805) 522-6646

LAS VEGAS, NV
4825 W. Flamingo Rd.
TEL: (702) 947-2673

COSTA MESA, CA
3033 S. Bristol
TEL: (714) 957-6900

SHERMAN OAKS, CA
14324 Ventura Blvd.
TEL: (818) 789-5805

SAN FRANCISCO, CA
350 Bay St.
TEL: (415) 421-8800

SAN DIEGO, CA
4766 Clairemont Mesa Blvd.
TEL: (858) 277-6686

BUY • SELL • TRADE • SERVICE

WOODLAND HILLS CAMERA
FEATURING TeleVue®
Eyepieces, Spotting Scopes, and Telescopes
at low prices!
Complete line in stock with excellent service.
Toll Free for Orders: 888-427-8766
Information: 818-347-2270 • Fax: 818-992-4486
5348 Topanga Canyon Blvd., Woodland Hills, CA 91364
BUY SELL TRADE

MASSACHUSETTS

Looking for a TeleVue dealer with 83 years experience, expert advice, service, before and after you purchase

TeleVue®

- Telescopes
- Eyepieces
- Binoculars
- Boston Showroom
- Used equipment
- Trade-Ins
- Repair Service
- Shipping Nationwide

F.C. Meichsner Co., Inc.
182 Lincoln Street, Boston, MA 02111
E-mail: meichs@aol.com
www.meichsner.com
(800) 321-VIEW (8439)

KANSAS

C&J PHOTOGRAPHIC EQUIPMENT

***We stock* Tele Vue®**
www.candjphoto.com
e-mail: chuck@candjphoto.com

TeleVue®
Visionary

9339 W. 87th St.
Overland Park, KS 66212
Toll free: 877-215-3686
Fax: 913-649-6009

NEVADA/PENNSYLVANIA

AMATEUR ASTRONOMERS...
VISIT EITHER OF OUR TWO FULLY STOCKED SHOWROOMS
AND SEE THE COMPLETE
TeleVue®
LINE ON DISPLAY !

We display and stock **Tele Vue-*101***, **Nagler™**, **Plössl**, and **Ranger**.

We ship everywhere and welcome mail and phone orders.
✸ Two showrooms to better serve you. ✸

Pocono Mountain Optics
104 NP 502 Plaza
Moscow, PA 18444
Orders: (800) 569-4323
Info: (717) 842-1500
Fax: (717) 842-8364
E-mail us at:
pocmtnop@ptdprolog.net

Pocono Mountain Optics

Pocono West Optics
2580 S. Decatur #3
Las Vegas, NV 89102
Orders: (800) 635-3607
Info: (702) 252-7200
Fax: (702) 252-7130
E-mail us at:
poconowest@bigplanet.com

Complete catalog & secure on-line ordering at: www.pocmtnop.com

NEW HAMPSHIRE

All **TeleVue®** Eyepieces In Stock.

***Rivers* CAMERA SHOP**
NO SALES TAX
Personalized Service Since 1930
454 Central ave. Dover NH 03820 • (800) 245-7963

NEW YORK

TeleVue®
"Tops in the Field"

focus Camera & Video
905 McDonald Ave. Brooklyn, N.Y. 11218
Toll Free: 888-221-0828
Orders & Info: 718-437-8810
Fax: 718-437-8811
E-Mail: orders@focuscamera.com
www.focuscamera.com
THE COMPLETE LINE OF TELE VUE TELESCOPES & EYEPIECES IN STOCK!

Pronto™
70mm ED SCOPE

Ranger
70mm ED SCOPE
Ivory, Brass or Green.

Many Packages Available!
www.focuscamera.com

NORTH CAROLINA

Tele Vue®

Complete Selection of Tele Vue® Telescopes, Spotting Scopes, Eye Pieces

Camera Corner
1-800-868-2462 • www.camcor.com
2273 S. Church St., Burlington, NC 27215
e-mail: sky@camcor.com

TeleVue®
Visionary
www.televue.com

OKLAHOMA

If it's TeleVue...

no matter whether it's a Pronto, Ranger, TV-85, TV-101, TV-102, Renaissance, Barlow, Plössl, Panoptic, Nagler, Radian, Paracorr, Powermate, Starbeam, Gibraltar, Tele-Pod mount, Sky Tour, Panoramic mount, Qwik-Point, Bino-Vue, or more . . .

we have it in stock!

astronomics
680 SW 24th Avenue, Norman, OK 73069
(800) 422-7876 24-Hour FAX: (405) 447-3337
our award-winning web site: www.astronomics.com
e-mail: questions@astronomics.com

WASHINGTON

Anacortes Telescope

ANACORTES
Telescope & Wild Bird

3202 Commercial Ave., Anacortes, WA 98221
PH (360) 588-9000 • FX (360) 588-9100
www.buytelescopes.com
We stock every
Tele Vue®
product.

Captain's Nautical Supplies
-EST. 1897-
Complete line of Tele Vue®
telescopes and eyepieces.
Expert optical instrument repair.
2500 15th Avenue W. (1 mile South of the Ballard Bridge)
Seattle, WA 98119
Phone: (206) 283-7242 • 1-800-448-2278 • FAX: (206) 281-4921

WISCONSIN

Complete selection of
Tele Vue®
telescopes, eyepieces & accessories

shipping nationwide

EAGLE OPTICS

Eagle Optics
2120 W. Greenview Dr. #4
Middleton, WI 53562 (608) 836-7172
Order Line: (800) 289-1132
www.eagleoptics.com

HOT SHOTS

A collection of your images and observations

SOUTHERN SKIES

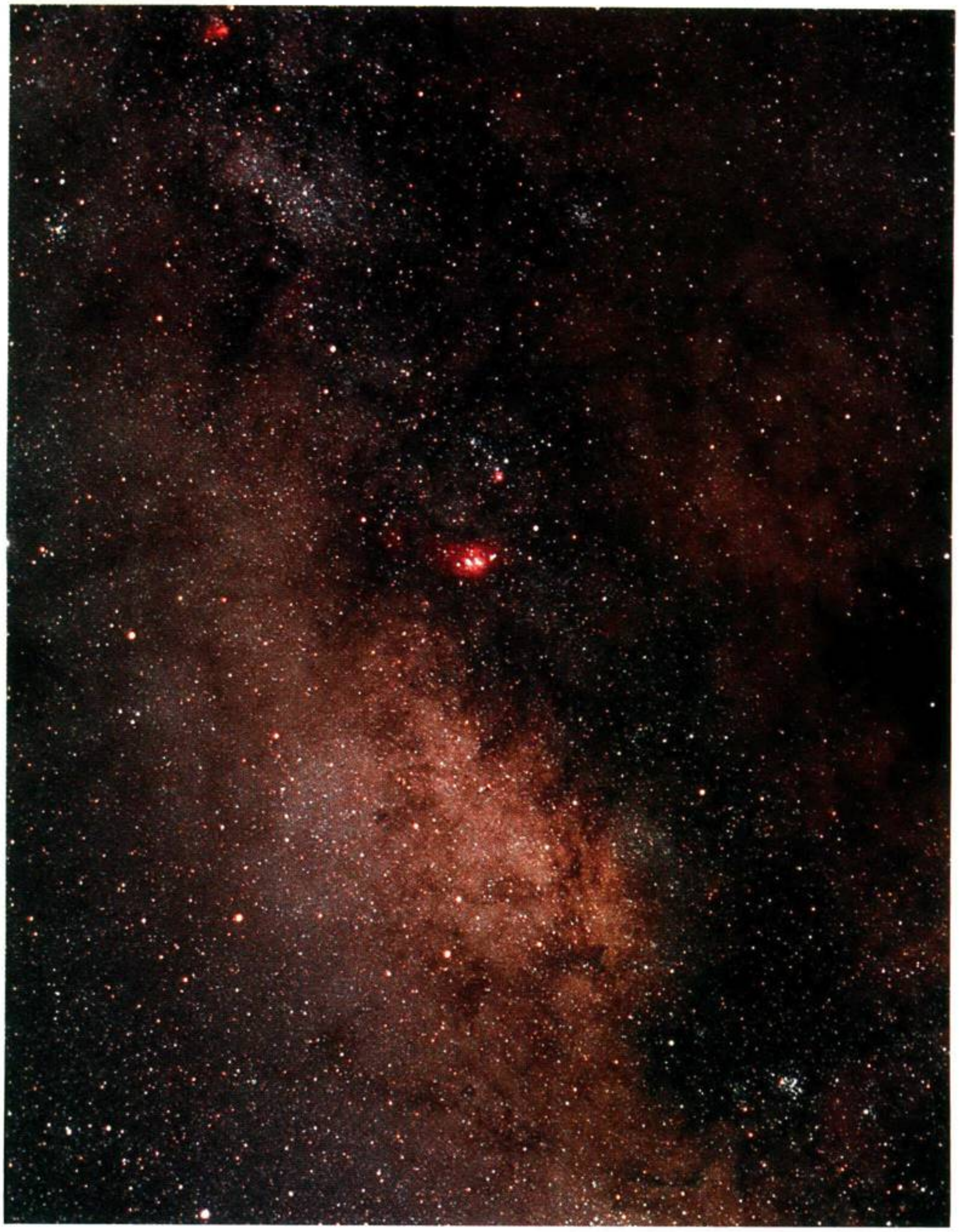
Naked-eye Galaxies

An odyssey into the outback reveals once-in-a-lifetime observational treasures.

▶ In March 1998, while perusing the web for observing sites in Australia, I came across the site for Grove Creek Observatory (www.gco.org.au). Grove Creek had everything I was hoping for: great equipment, experienced staff, sleeping accommodations, and a full-service kitchen. The price was also extremely reasonable. I contacted Steven Williams, the head astronomer at Grove Creek Observatory. I told Steven which objects I was interested in viewing and he recommended reserving time in the month of April. I made a reservation for the evenings of April 14, 15, and 16, 1999.

My traveling companion was my father. Every astronomical event my father has attended with me has brought clear skies. I really needed his observing luck and companionship for this long journey. We spent two days sight-seeing in Sydney before traveling to the observatory, and afterward we traveled to the South Island of New Zealand to do a marathon 5-day tour.

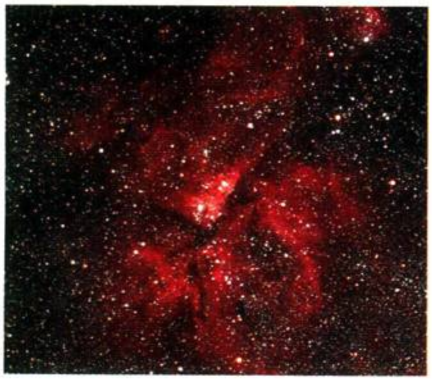
Grove Creek Observatory is located on a sheep farm about 270 kilometers (168 miles) southwest of Sydney in the Blue Mountains. Steven, and the observatory's owner, Jim Lynch, greeted us on the 14th and gave us a tour.



Center of the Milky Way

JAMES KELLY

(90mm lens at f/4, Kodak Pro 400 PPF film, composite of two 30-minute exposures)



Eta Carinae Nebula

JAMES KELLY

(4-inch refractor at f/4, Kodak Pro 400 PPF film, composite of two 30-minute exposures)

The first night was clear except for a fantastic lightning display from a thunderstorm parked over Sydney. We couldn't do any photography that night due to the lightning, so Steven gave us an unbelievable visual tour of the southern skies using a 14-inch SCT. The next day we learned that the thunderstorm dropped baseball-size hail on Sydney. We escaped just in time. The following two nights were perfectly clear. Steven and I took pictures of just about everything we could in the time allotted.

I'll never forget seeing the Large and Small Magellanic Clouds for the first time. I never thought I would see galaxies the size of the moon with my naked eye! The galactic structure of the Milky Way was clearly visible stretching from the Southern Cross to Cygnus. I feel fortunate to have seen the beautiful terrestrial scenery in New Zealand and the extraterrestrial scenery at Grove Creek Observatory. Steven and Jim not only provided a wealth of astronomical knowledge, but they really made us feel at home even though we were on another continent. ◼

James M. Kelly lives in Bloomingdale, Illinois, and works as a technical consultant. He is a member of the Peoria Astronomical Society.

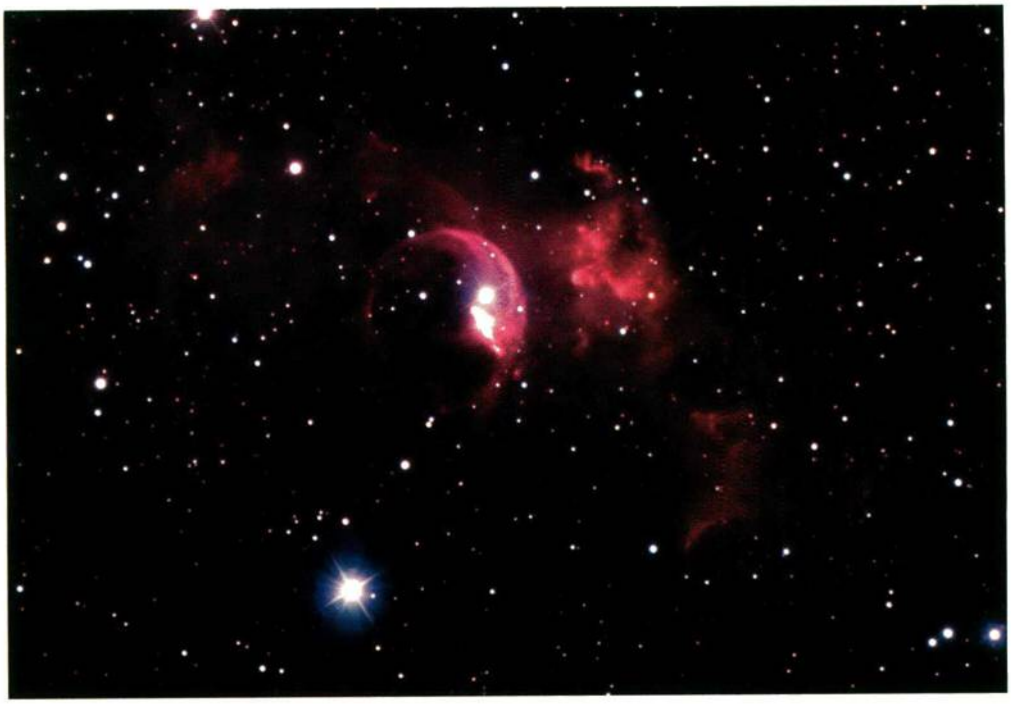
Share Your Stories

Send your 500- to 800-word reports describing your observing experiences to:

Hot Shots, *Astronomy* magazine, P.O. Box 1612, Waukesha, WI 53187-1612

Or e-mail them to:

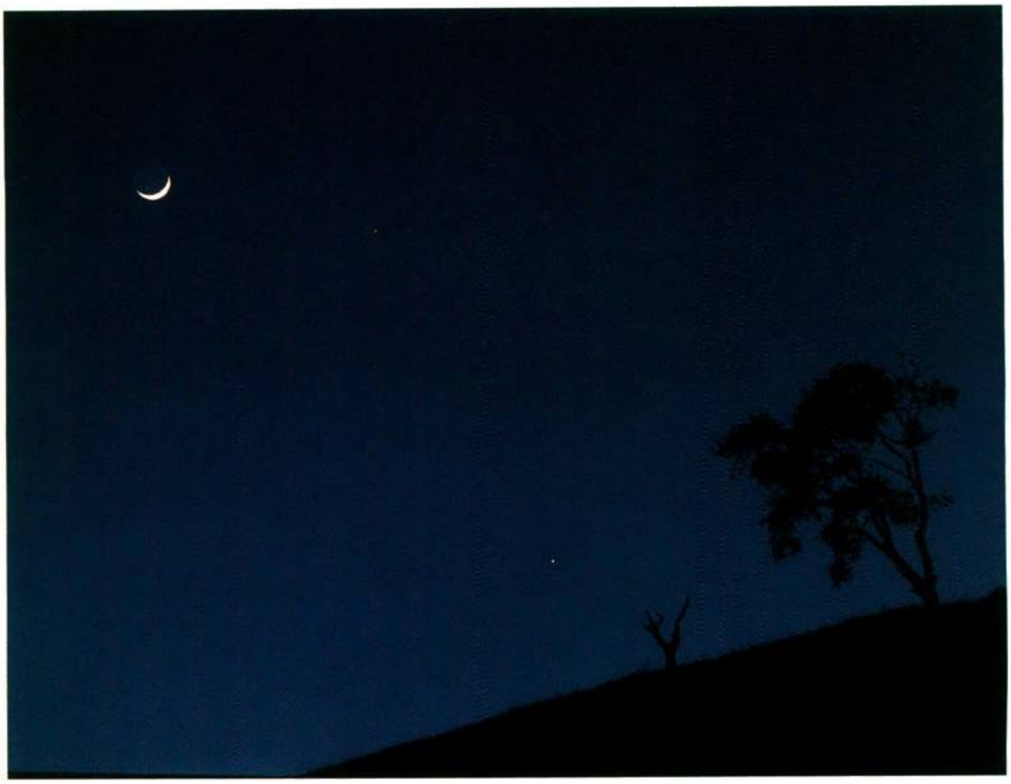
hotshots@astronomy.com



The Bubble Nebula (NGC 7635)

ROBERT GENDLER

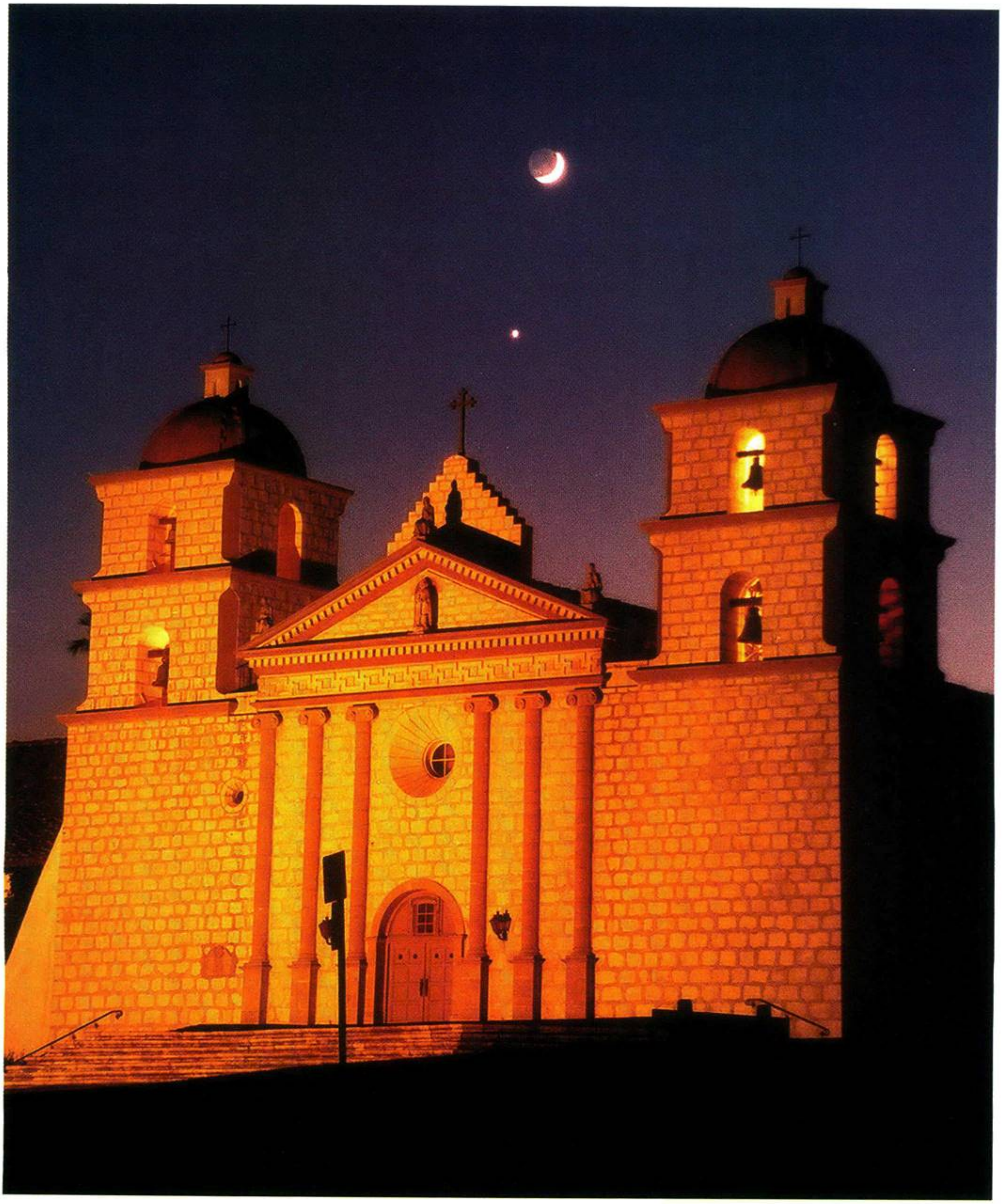
(12.5-inch f/9 Ritchey-Chrétien scope, ST8E CCD camera, 80-minute red filtered luminosity, 10-minute red, 10-minute green, and 20-minute blue exposures)



Jupiter, Saturn, and Mars Mingle with the Moon

JIM BAUMGARDT

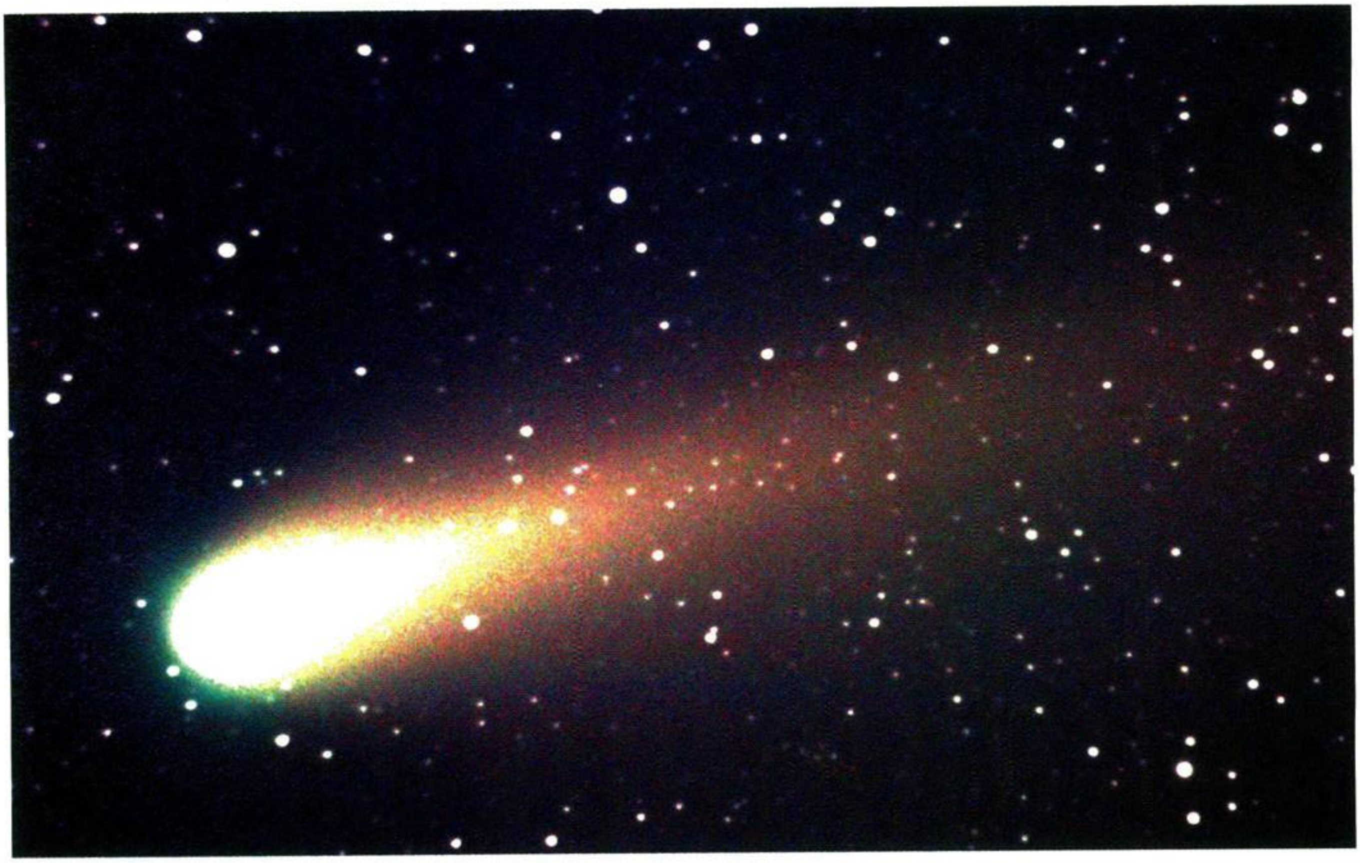
(70mm lens at f/4, Fuji Provia 100 film, 8-second exposure taken April 6, 2000)



Moon and Venus over Santa Barbara, California

MARK BRIGHT

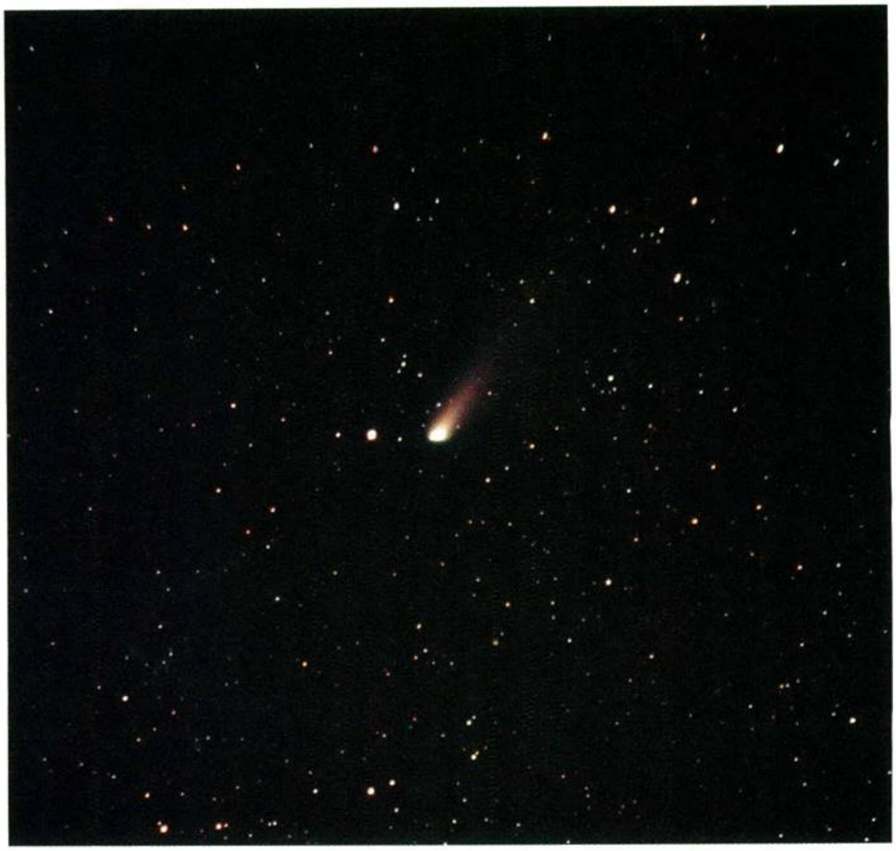
(70mm lens, Fuji Super HQ 100 film, taken July 16, 1999)



LINEAR in Living Color

JACK NEWTON

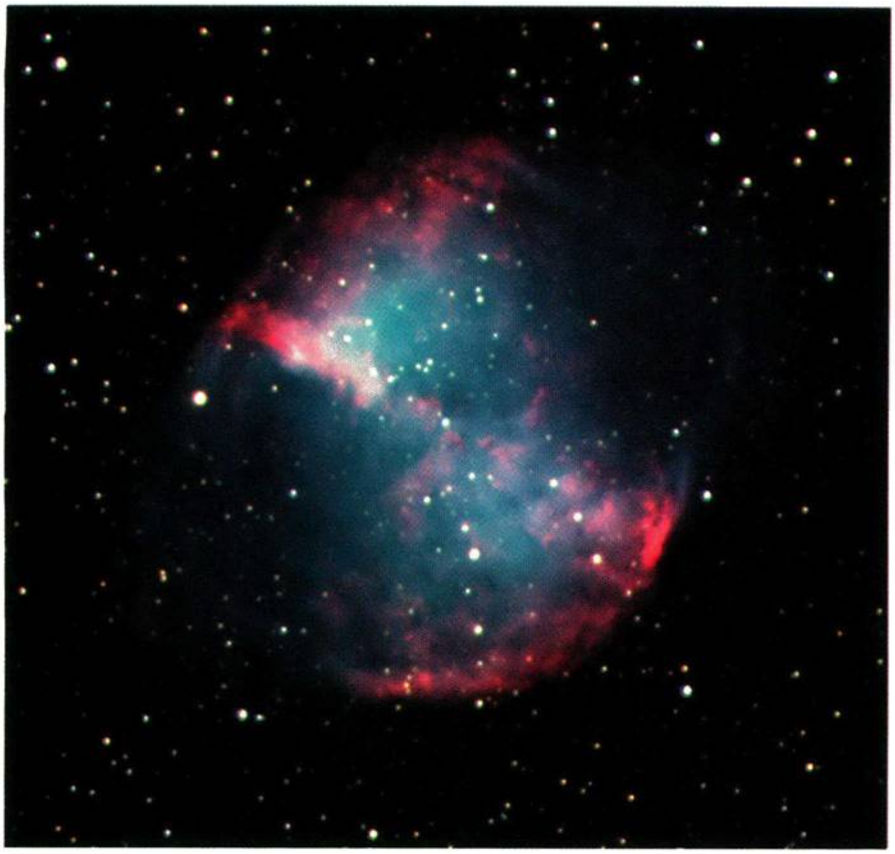
(16-inch SCT, 1616XTE CCD camera, 1-minute LRGB exposure taken July 13, 2000, at 2 A.M. PDT)



Comet LINEAR

VALENTIN VILLALOBOS

(10-inch f/4.5 reflector, Kodak PPF 400 film, 10-minute exposure taken July 7, 2000)



The Dumbbell Nebula (M27)

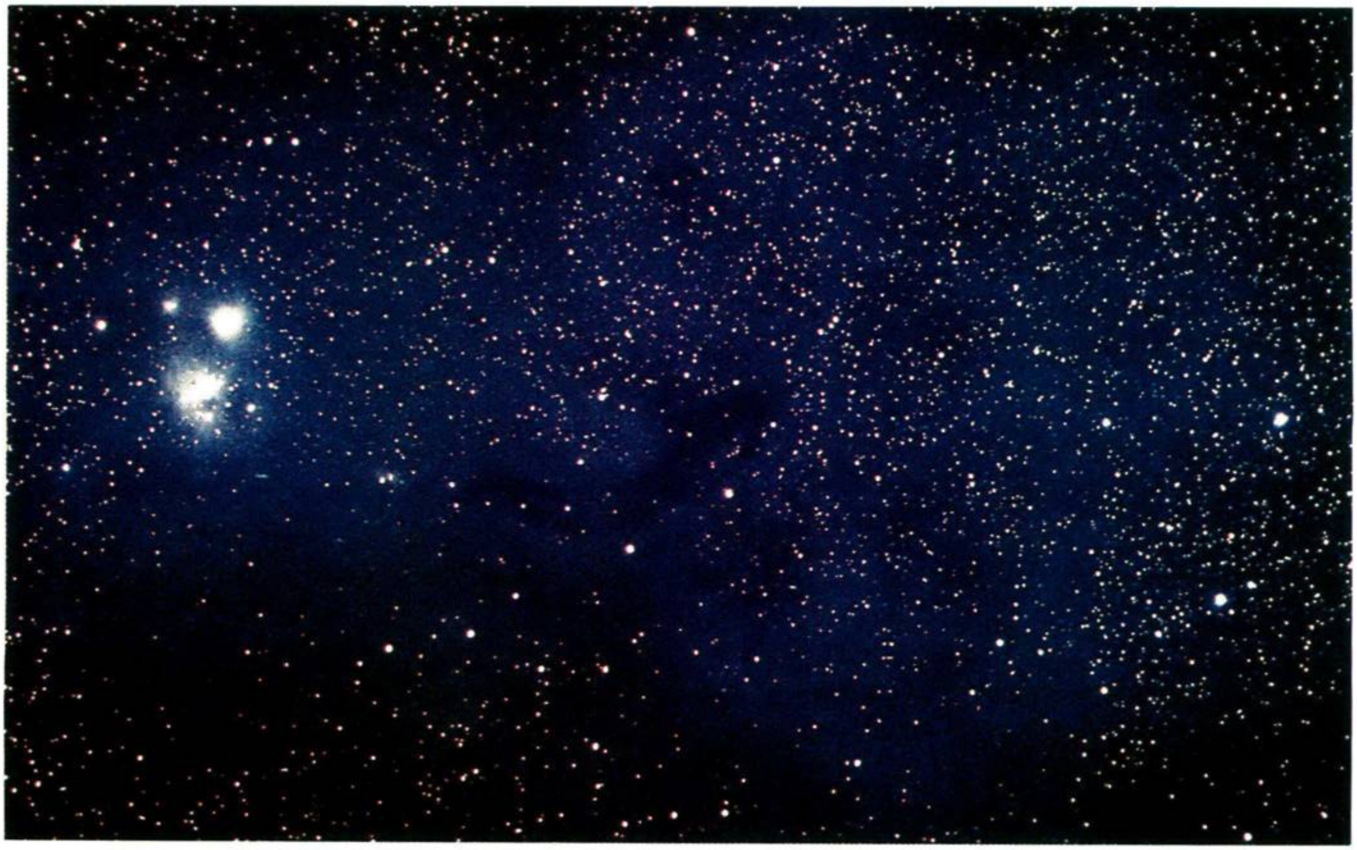
DAVID HANON

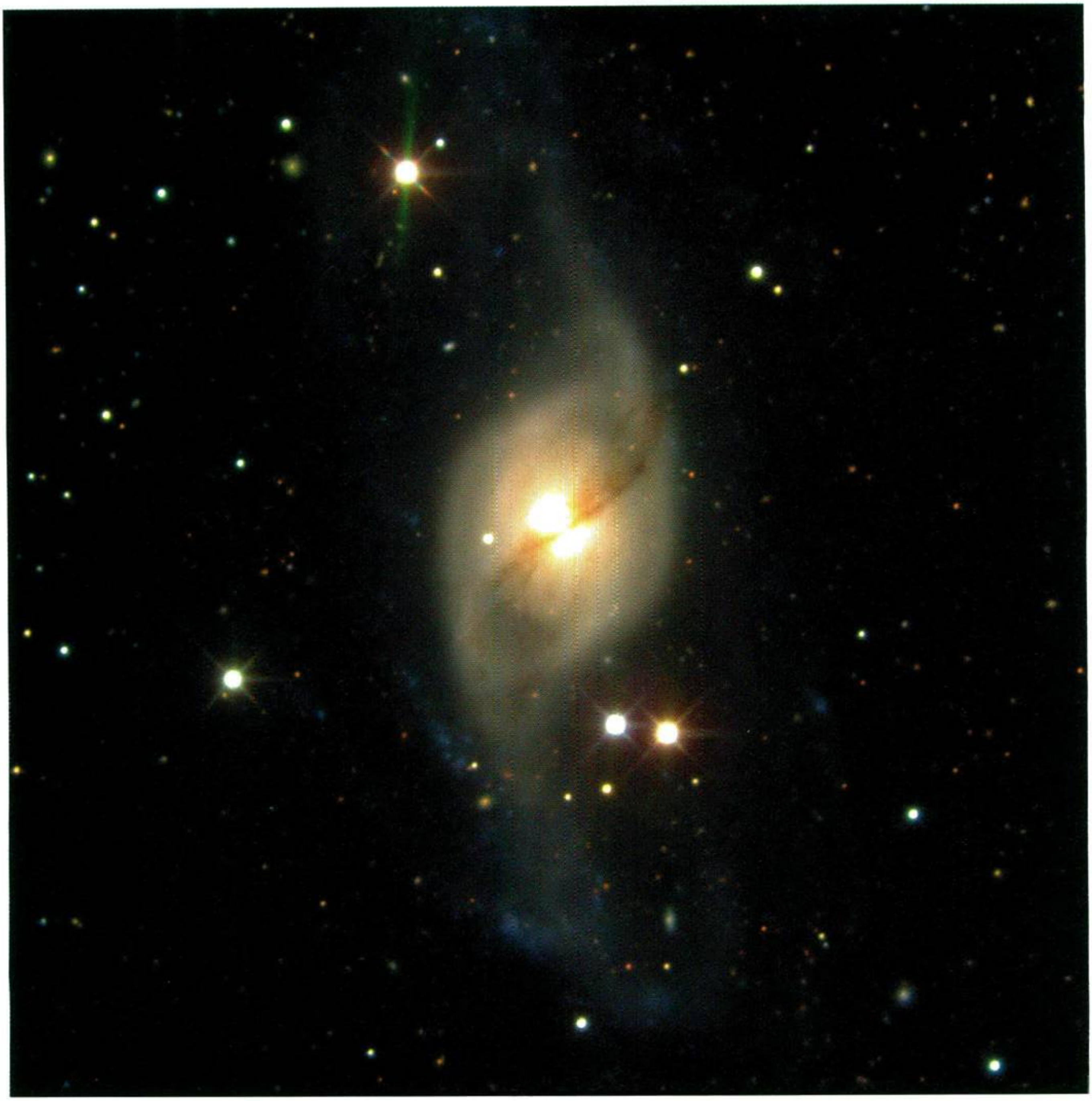
(7-inch refractor at f/7, ST-8E CCD camera, composite of 30-minute red, 30-minute green, and 30-minute blue exposures)

Reflection Nebula IC 348 in Perseus

GEORGE GREANEY

(6-inch f/7 refractor, 120 format Kodak PPF Pro 400 film, composite of two 60-minute exposures)





Odd Galaxy NGC 3718 in Ursa Major

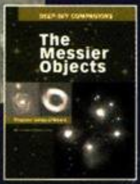
AL KELLY

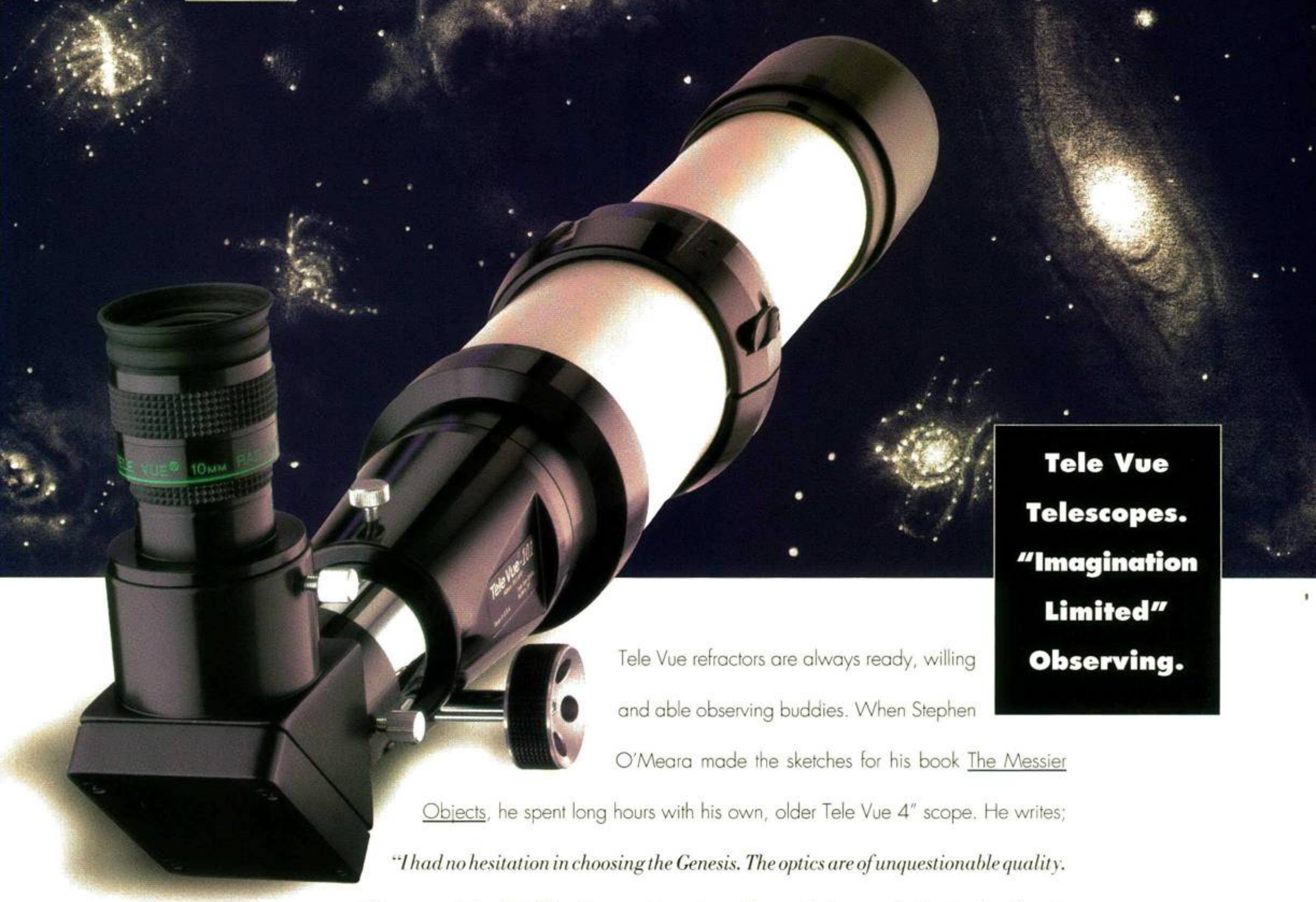
(Image by Al Kelly with the help of Arne Henden of the U.S. Naval Observatory in Flagstaff, Arizona, using the USNO 1.0-meter Ritchey-Chrétien scope. Arne made images using blue, green, and red filters and Al composited them and created the luminance layer from a stack of all the images.)

The barred spiral galaxy NGC 3718, also cataloged as Arp 214, is a rarely photographed gem with an unusual structure.

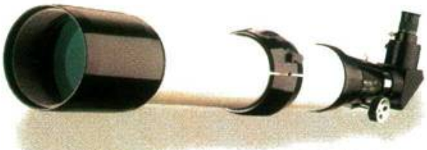
How a leading expert chose Tele Vue

Stephen James O'Meara, author, Sky & Telescope editor and first to visually recover Halley's comet. Drawings by Stephen James O'Meara


DEEP-SKY COMPANIONS
The Messier Objects


TELE VUE® 10MM RADIAN
Tele Vue-102
Tele Vue Telescopes. "Imagination Limited" Observing.

Tele Vue refractors are always ready, willing and able observing buddies. When Stephen O'Meara made the sketches for his book The Messier Objects, he spent long hours with his own, older Tele Vue 4" scope. He writes; *"I had no hesitation in choosing the Genesis. The optics are of unquestionable quality. When coupled with Tele Vue eyepieces (equally revolutionary designs), the Genesis transcends the traditional limitations of long-focus and rich-field refractors, combining the best qualities of both. Genesis and I met serendipitously under dark Texas skies, where I realized its quality and potential. The rest is history."* Stephen discovered a primary virtue of all Tele Vue scopes - versatile performance. Take one along for "imagination limited" observing.



Tele Vue 101: flat field APO, f/5.4
102: APO, f/8.6

Tele Vue 85: APO, f/7.0

Pronto: 70mm ED, f/6.8

Ranger: 70mm ED, f/6.8

Tele Vue® Dept A, 100 Route 59, Suffern, NY 10901 (845) 357-9522 www.televue.com

The North America Nebula (NGC 7000) and Pelican Nebula (IC 5067, 5070) in Cygnus. Photographed by Jason Ware with the Meade 12" f/2.2 Schmidt Camera. A composite of two 15-minute exposures on Fuji Superia (100 ASA) film and one 30-minute exposure on Kodak Tech Pan film with #92 red filter. The three exposures were scanned, digitally combined, and processed to obtain the final image.

The largest-selling telescopes in the world.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450
FAX: (949) 451-1460 ■ *www.meade.com*
© 2000